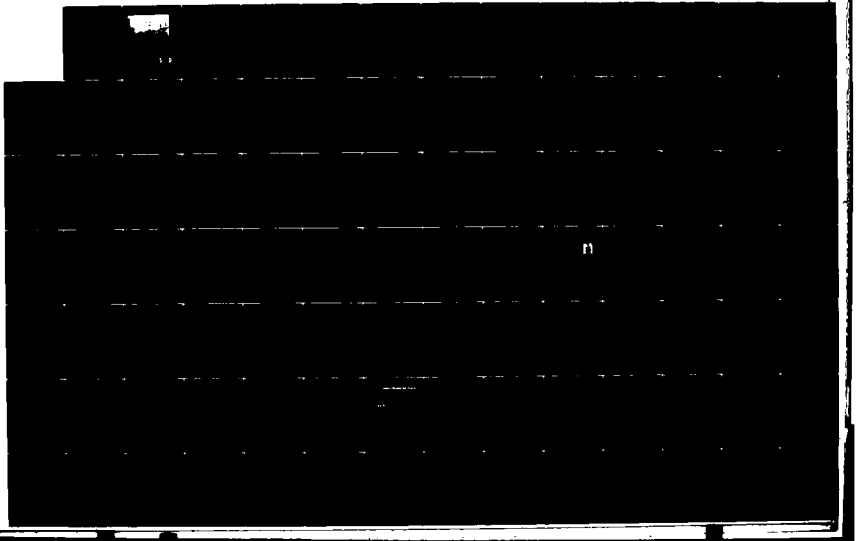
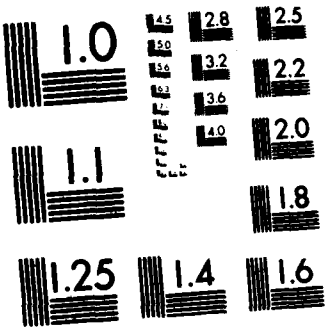
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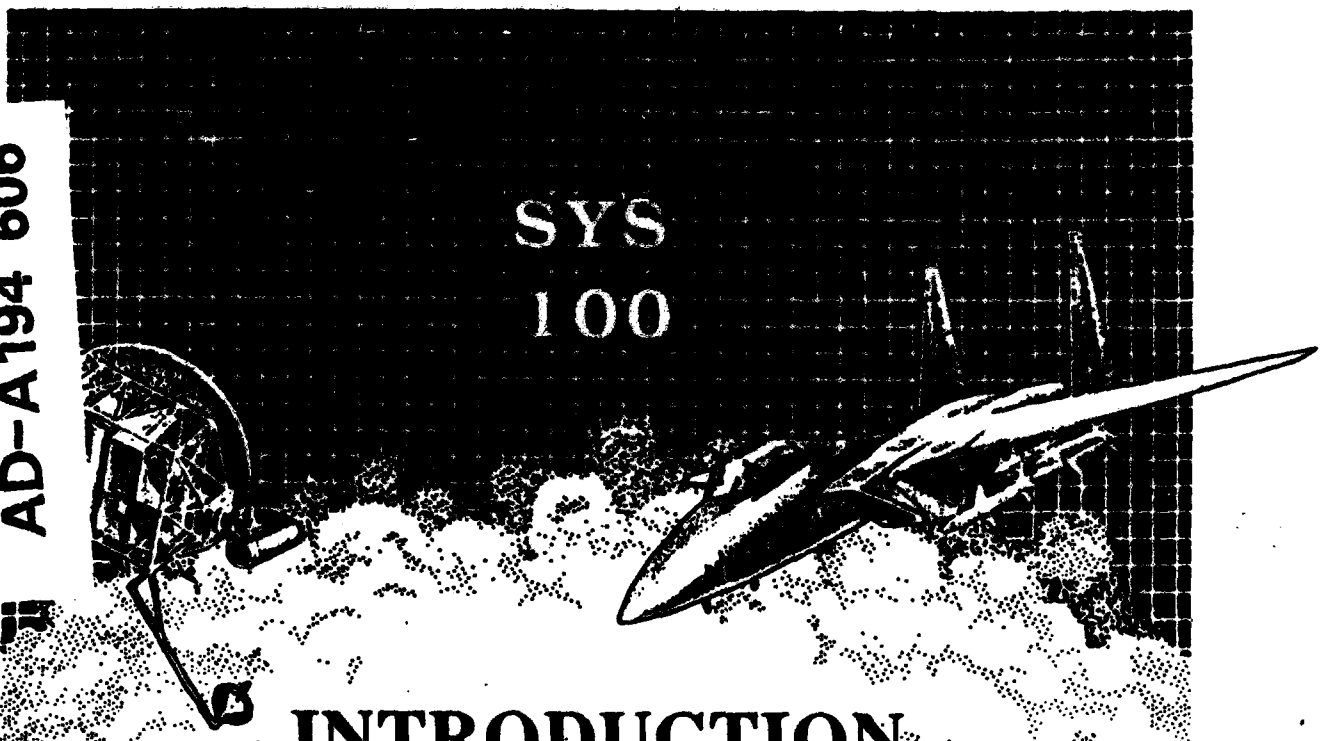




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INTRODUCTION TO ACQUISITION MANAGEMENT

TEXTBOOK

DECEMBER 1987

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Department of the Air Force
Air University

AIR FORCE INSTITUTE OF TECHNOLOGY
School of Systems and Logistics
Department of System Acquisition Management

Wright-Patterson Air Force Base, Ohio

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The purpose of this manual is to review the latest DOD and Air Force directives, instructions, and regulations as an introduction to the system acquisition process. The manual provides a broad perspective of the system acquisition process and then expounds on the major functional areas in the process.

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INTRODUCTION TO ACQUISITION MANAGEMENT

SYS 100

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1987 EDITION

PREPARED FOR

AIR UNIVERSITY

THE AIR FORCE INSTITUTE OF TECHNOLOGY

SCHOOL OF SYSTEMS AND LOGISTICS

WRIGHT-PATTERSON AFB, OHIO

QUALITY INSPECTED

CAPT TERRY R. ADLER .....COURSE DIRECTOR

ERNEST R. KEUCHER .....EDITOR

PREFACE

This seminar TEXTBOOK is specifically designed to stimulate discussion and encourage inquiry by the students participating in the Introduction to Acquisition Management, SYS 100.

The questions posed herein are confined to subjects contained in the videotapes and text readings. It is, of course, critical to the understanding and application of Acquisition Management that each student diligently read and digest the text material before proceeding to the seminar discussion questions and problems. This problem oriented approach marks the distinction between the Seminar Program and Correspondence Text in Acquisition Management presented by the Extension Course Institute at Gunter AFS, Alabama.

ACKNOWLEDGEMENTS

This Seminar Textbook was prepared for the Air Force Institute of Technology's School of Systems and Logistics under the general guidance of Colonel Larry L. Smith, USAF, Dean and Lt Colonel John Dumond, Head of the Department of Systems and Logistics. Special thanks are due to Mr. Jon Graham, Lt Colonel Jon Carleton and Mrs. Sandi Ramroth, all of the Academic Operations and Support Division, for their administration and promotion of the seminar program.

Many faculty and staff members made major contributions to this Textbook. Two members who should be highlighted for their diligent and faithful support are Katherine Hellmann and Anita Poulter. Their efforts greatly contributed to the publication of this manual.

Mar 87
Jun 87
Dec 87

Terry Adler, Course Director
Ernest R. Keucher, Editor

THIS PUBLICATION HAS BEEN REVIEWED AND APPROVED BY COMPETENT PERSONNEL OF THE PREPARING COMMAND IN ACCORDANCE WITH CURRENT DIRECTIVES ON DOCTRINE, POLICY, ESSENTIALITY, PROPRIETY, AND QUALITY.

TABLE OF CONTENTS

Section		Pg(s)
	Title Page	iii
	Preface	iv
	Acknowledgements	iv
	Table of Contents	viii
1.	Course Objective(s)	ix
2.	Course Description	ix
3.	Course Outline	x
4.	Administrative Information	
	a. Attendance Policy	xi
	b. Instructional Methods, Academic Freedom & Non-Attribution	5
	c. Student Preparation	xi
	d. Class Leader Responsibilities	xii
	e. Student Evaluation of Course	xii
5.	Evaluation Criteria/Grading Policy	xii
6.	Class Schedule	xii
7.	Individual Lesson Plans	xiii
	a. Introduction to Acquisition Management	1-1
	b. Internal Program Management	2-1
	c. External Program Management	3-1
	d. Acquisition Process	4-1
	e. Planning, Programming, and Budgeting System	5-1
	f. Solicitation Process	6-1
	g. Contract Management	7-1
	h. Communication Exercise	8-1
	i. Systems Engineering	9-1
	j. Integrated Logistics Support	10-1
	k. Configuration Management	11-1
	l. Data Management	12-1
	m. Manufacturing Management	13-1
	n. Test and Evaluation	14-1
	o. Program Control/Cost Estimating	15-1
8.	Appendix	
	Acronyms	A-1
9.	Index	I-1

Section 1

COURSE OBJECTIVE

The purpose of AFIT Course SYS 100, Introduction to Acquisition Management, is to increase the effectiveness of Air Force Personnel entering the field of Systems Acquisition for the first time. It provides the foundation for further learning on the job and in other specialized courses. Current concepts and problem areas in the acquisition process are explored throughout the course.

The objectives of the course are for each student to know:

a. The environment in which defense systems are acquired.

b. The organization, mission, and responsibilities of the program office.

c. The vocabulary of systems acquisition.

Section 2

COURSE DESCRIPTION

SYS 100 consists of video lectures and group discussions in two main subject areas. The first area includes an overview of the Acquisition Process including presentations on the types of acquisition programs; the program manager's role; the program management organization; the program management environment; the acquisition process; the Planning, Programming, and Budgeting System (*PPBS*); the Solicitation process; the Contracting process; and, the Communication Exercise. The second area includes an overview of the roles of the major functional disciplines within the program office. In this area, the disciplines of Systems Engineering, Integrated Logistics Support (*ILS*), Configuration Management, Data Management, Manufacturing Management, Test and Evaluation, and Program Control/Cost Estimating are discussed. Details of each lesson are provided in Section 7 of this syllabus.

Section 3

COURSE OUTLINE

Lesson or Activity	number of hours
a. Course Registration/Orientation	1
b. Introduction to Acquisition Management	1
c. Internal Program Management	1
d. External Program Management	1
e. Acquisition Process	2.5
f. Planning, Programming, and Budgeting System	3
g. Solicitation Process	1
h. Contract Management	2

i. Communication Exercise	1.5
j. Test #1 and review	1
k. Systems Engineering	2
l. Integrated Logistics Support	2
m. Configuration Management	2.5
n. Data Management	1
o. Manufacturing Management	2
p. Test and Evaluation	2
q. Program Control/Cost Estimating	1.5
r. Test #2 and review	1
s. Course Summary, Critique and Graduation	1
Total	30

Section 4

ADMINISTRATIVE INFORMATION

a. *Attendance Policy*:

While attending this course, students, including local area students, are in a TDY status to AFIT and are thus responsible to, and under the supervision and administration of the Dean, School of Systems and Logistics. The Dean has prescribed that students:

(1) Will be present in class at the designated hours.

(2) Will be excused from attendance only if ill, or as otherwise excused by the course director.

(3) Be aware that dental appointments, vehicle maintenance, committee meetings, requirements of a regularly assigned job, etc., are not normally valid causes for class absence.

(4) Will notify the course director or the class leader of location or destination if leaving the local area during weekends.

b. *Instructional Methods, Academic Freedom, Nonattribution*:

Classroom videotape presentations are made by faculty members of the School of Systems and Logistics and by selected guest speakers. Course facilitators are provided to enhance the material presented including class discussions. Instructional methods include videotaped lecture, discussion, demonstration, performance, exercise and related instruction.

The course facilitator, guest lecturers, and each student, within the bounds of courtesy and propriety, is encouraged to participate and freely discuss the subject matter presented. Case histories or examples of actual practice are for illustration and classroom discussion only and are strictly on a nonattribution basis.

(1) Academic freedom: The privilege of debate with discretion on any subject related to curricula within the school forum.

(2) Non-attribution: Treating statements made in the school forum as privileged information not to be attributed to a specific individual when outside the school forum.

c. *Student Preparation*: Student are expected to:

(1) Read scheduled assignments in advance.

(2) Remain alert and attentive in class

(3) Take notes. Notes in your own words add greatly to your retention of material presented.

(4) Participate actively in discussions, but please do not monopolize or sidetrack them.

(5) Remember that some of the speakers are our guests and are contributing their time and efforts to aid our program. Treat them accordingly.

d. *Class Leader*: On the first day of class a class leader will be appointed. The class leader will be the senior military class member or the senior civilian class member when no military are present. The class leader's basic responsibilities include:

(1) Maintaining classroom decorum.

(2) Monitoring class attendance (see AFIT Form 67).

(3) Serving as a focal point to provide student feedback on the content and conduct of the course to the course director and the department head.

e. *Student Evaluation of Course*: There are four principal means of obtaining student evaluation of the course content and conduct.

(1) Direct feedback to the course director at any time and/or at the final class session.

(2) Student end-of-course written appraisal submitted at the final class session.

(3) Student class leader debriefing on the last class day with the department head.

(4) Post-course (approximately 6 months) surveys of selected classes.

Section 5

EVALUATION CRITERIA/GRADING POLICY

The School of Systems and Logistics (*LS*) offers no academic credit for the SYS 100 course. The course is evaluated on a pass/fail basis only. The students will be evaluated by a quiz and a final examination. The quiz will cover the material in the first block of instruction, and the final examination will cover all of the material in the course. The

student's final grade for the course will be determined by the student's performance on both the quiz and the final examination. The quiz will be 1/3 of the final grade and the final examination will be 2/3 of the final grade. A combined grade of 60% is required to pass the course. Students completing this course will be issued grades of *S* (Satisfactory) or *U* (Unsatisfactory) reflecting their performance during the course. Students who are unable to complete the course will be issued a grade of *W* (Withdrawn).

Section 6

CLASS SCHEDULE

The detailed class schedule for the course varies with each offering. Therefore, each student is given a copy of the class schedule during the class registration period.

Section 7

INDIVIDUAL LESSON PLANS

The remainder of this document is a detailed description of each lesson in the SYS 100 course. The following is a simple explanation of key parts of the syllabus lesson plan page that should be of great interest to the student.

a. Time: Approximate number of classroom hours to be spent on the lesson.

b. Lesson Objective: A broad statement of the ultimate student outcome.

c. Samples of Behavior: Specific identification of what each student should be able to do at the completion of a lesson.

d. References: Major documents used as source data for lesson content.

e. Instructional Material: A listing of the materials the student is provided as a routine part of the curriculum. However, students may receive additional supplemental materials during the conduct of the class. Unless otherwise specified, this supplemental material is optional and nontestable.

f. Student Preparation: Actions the student must accomplish before a particular lesson is formally presented in class.

LESSON 1

LESSON TITLE: **Introduction to Acquisition Management**

TIME: 1 hr

LESSON OBJECTIVE: The objective of this lesson is for each student to know what is meant by the terms acquisition program, program direction, and system; the role of the Statement of Operational Need (*SON*); and the three categories of Air Force acquisition programs.

SAMPLES OF BEHAVIOR: Each student will be able to:

a. Define acquisition program.

b. State the kind of appropriations used to fund acquisition programs.

c. Describe a system.

d. State the vehicle for validating an operational need.

e. State the purpose of the System Operational Requirements Document (*SORD*), and Depot Support Requirements Document (*DSRD*).

f. State the primary vehicle for program direction from HQ USAF to the Major Command Headquarters.

g. List and describe the primary criteria for the three categories of Air Force Acquisition Programs.

TOPIC INTRODUCTION:

The government is a very large user of supplies and services purchased in the market place. With the high quantity, complexity, and costliness of items purchased by the Government, the requirements placed upon the acquisition community are growing more and more demanding. This lesson introduces some fundamental terms and concepts necessary to understand the acquisition process. Critical to understanding how an acquisition program works is understanding what, exactly, an acquisition program is and is not. An acquisition program, in this course, is not the procurement of base level supplies or services (like food, linens, or toilet paper, for example) that are common to every Air Force base. Rather, an acquisition program deals with research, development, test and evaluation, procurement, and security assistance programs in providing a new or improved capability.

The type of funds used in acquiring these weapon systems are introduced as background. Buying a weapon system means the acquisition of not only the system hardware, but, also, the acquisition of data, training, spares, and all other elements required to operate and maintain the weapon system. Several documents are introduced that initiate the acquisition process and the documents purpose in the program life-cycle. Finally, the different types of Air Force acquisition programs, and their criteria, are discussed, highlighting the fact that not all acquisition programs are the same (i.e., some may have higher or lower priority than *your* program).

Think of this lesson as the starting point in a new program. Imagine a program that is just getting off the ground and you are the program manager. You have very

little acquisition experience and you are taking this accelerated course to bring you up to speed on what is happening all around you. (Sound familiar?) Assume that your program meets a validated need and, now, you are ready to learn basic knowledge necessary to manage your program.

METHOD OF INSTRUCTION: Lecture

INSTRUCTIONAL MATERIALS:

a. Article, *The Acquisition of Major Systems*, by Mr McCarty, AFIT/LSY
b. Article, *Operational Requirements Process*, by Capt Andrews
c. *Introduction to Acquisition Management* videotape
d. Lesson viewgraphs

AUDIO-VISUAL AIDS: Chalkboard

INSTRUCTIONAL EQUIPMENT: Video monitor and 3/4" tape player

REFERENCES:

a. DOD Directive 5000.1, *Major System Acquisition*
b. AFR 800-2, *Acquisition Program Management*
c. AFR 57-1, *Operational Requirements: Operational Needs Requirements, and Concepts*
d. AFSCP 800-3, *A Guide for Program Management*

REQUIRED STUDENT PREPARATION:

a. Read article: *The Acquisition of Major Systems*
b. Read article: *Operational Requirements Process*
c. Scan lesson viewgraphs

DISCUSSION QUESTIONS:

1. Discuss the concept of the "system" as used in the Air Force acquisition process. Why is this important for management?

2. Describe the term "validated need" and state the vehicle for validating a need.

3. Describe the primary criteria for the categories of Air Force Acquisition programs.

[Acronyms introduced in this lesson, and their descriptions]

ACRONYMS

[The following acronyms are first used and identified in this lesson]

Chapter 1

ADM	Acquisition Decision Memorandum
AFDAP	Air Force Designated Acquisition Program(s)
AFSARC	Air Force System Acquisition Review Council
CI	Configuration Item(s)
DAB	Defense Acquisition Board
DAE	Defense Acquisition Executive
DCP	Decision Coordinating Paper
DPML	Deputy Program Manager for Logistics
DSRD	Depot Support Requirements Document
DT&E	Development Test and Evaluation
FYDP	Five Year Defense Program
IOC	Initial Operational Capability
IOT&E	Initial Operational Test and Evaluation
IPS	Integrated Program Summary
JSOR	Joint Systems Operational Requirement
LRIP	Low Rate Initial Production
MAJCOM	Major Commands
MNS	Mission Need Statement
OPR	Office of Primary Responsibility
OT&E	Operational Test and Evaluation
PDP	Program Decision Package
PM	Program Manager
PMD	Program Management Directive
PMRT	Program Management Responsibility Transfer
PO	Program Office
POM	Program Objective Memorandum
PPBS	Planning, Programming and Budgeting System
P3I	PrePlanned Product Improvement
RCM	Requirements Correlation Matrix
RDT&E	Research, Development, Test and Evaluation
RFP	Request(s) for Proposal
SCP	System Concept Paper
SECDEF	Secretary of Defense
SOA	Separate Operating Agencies
SON	Statement of Operational Need
SORD	System Operational Requirements Document
SPO	System Program Office
T&E	Test and Evaluation

WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

THE ACQUISITION OF MAJOR SYSTEMS

MR. DYKE MCCARTY
AUG 1987

SECTION I
INTRODUCTION

Military managers of system acquisitions often find themselves in the spotlight because of news stories about cost overruns, project delays, and technical difficulties. The scrutiny and exposure which the military program manager (*PM*) receives is correct and fundamental to our system of government, but this examination makes the program manager's job additionally demanding and complex. In fact, directing the acquisition of a major defense system ranks high among the most complex challenges facing managers anywhere in our society. This paper is an attempt to outline, in broad terms, the environment in which the PM operates, the direction he [1] follows, and the decision process which controls the program -- all in the context of the life cycle of a ***typical*** major program.

SECTION II
SYSTEM ACQUISITION MANAGEMENT

A weapon or support system is more than just the mission equipment; a weapon/support system includes peculiar support equipment, supplies, spare parts, technical orders and manuals, training programs and training equipment, etc. (See Figure 1). Therefore, in a system development, all the many elements must be considered, developed, and procured so that together they provide an operational capability. System acquisition management is the process whereby the diverse tasks, functions, and resources required are integrated and focused upon the development of a necessary capability on time and within budget.

A key concept of system acquisition management is the designation of a single manager to be responsible for all of the technical and business aspects of a program. That manager must then assemble a team to assist in accomplishing the program objectives. The management team is formed by drawing personnel from all of the appropriate functional areas and placing them under the control of the program manager (*PM*). The program manager is given the authority required to carry out his responsibilities and is held accountable for the accomplishment of the total management task. For example: a yearly budget must be prepared, defended, and managed; schedules must be developed and adhered to (or deviations must be justified); mission hardware must be designed, developed, tested and produced; a capable logistic support system must be assured;

1Whenever the words *he* or *him* appear in this paper, except in reference to a specific person, it should be understood that *she* or *her* may be substituted

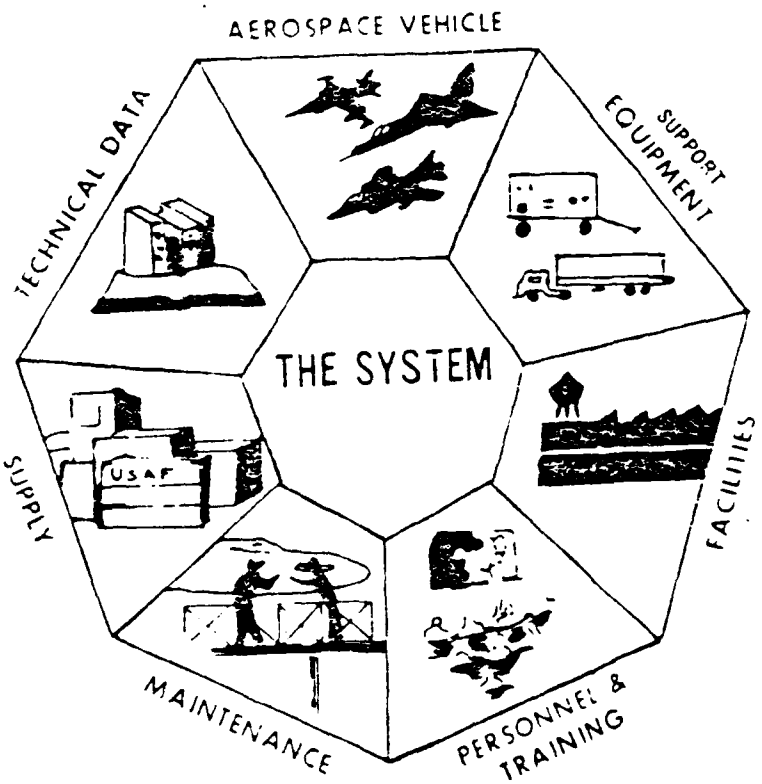


Figure 1

contractors must be selected, and contracts negotiated and administered. The team operates through a system program office (*SPO*) (See Figure 2). The SPO is headed by the program manager, who reports to a senior defense executive. Thus, the SPO is removed from the basic functional structure and the PM is provided a discrete line of authority so that the broad and multiple requirements of system acquisition can be met. Central to the system management concept is the philosophy that the PM must serve as the overseer of the broadest Air Force interests in order to develop the most effective solution to mission needs through the efficient use of the available resources. That entails focusing the various functional skills available within the SPO team upon the achievement of a common goal, and balancing a variety of requirements to avoid compromising that goal. Ideally, each program will develop and produce the most effective, easily supported, reliable, technologically advanced, yet cheapest and simplest solution to our mission needs and will do it in record time. Unfortunately, those goals are not all mutually supporting and it is the PM who must provide the perspective to represent each of the goals so as to achieve an affordable, supportable, and effective system in time to meet the need. The program objectives are defined by the Air Force and approved by the Secretary of Defense (*SECDEF*). Therefore, the essence of the program manager's role is to be the agent of the Service in the management of the system acquisition and the focal point of authority and responsibility for running the program.

It is a truism that each system acquisition program has its unique features and, therefore, no two programs are identical. For example, differences in technology, cost, schedule, priority, and funding are normal and must be accommodated. However, despite the differences, there is a basic process or cycle common to all programs, and that

SINGLE BASIC SYSTEM PROGRAM OFFICE

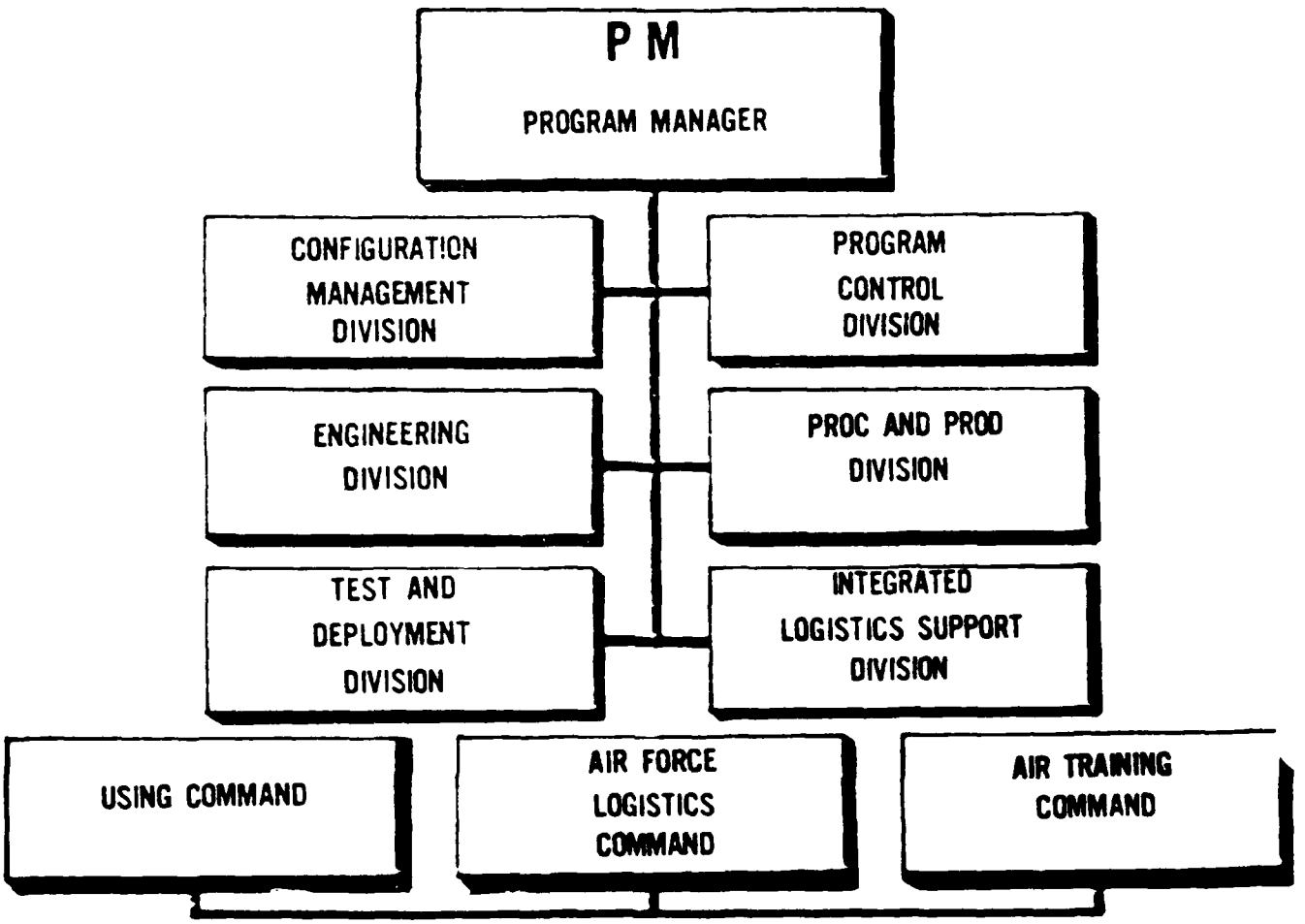


FIGURE 2

is what this paper will discuss.

System acquisition programs go through a sequence of key program decisions, milestones, and activities known as the system acquisition process or system acquisition life cycle (See Figure 3). The system acquisition life cycle is essentially a logical flow of activity representing an orderly progression from an identification of system need to final operational deployment. Each PM must be prepared to develop a tailored management approach which will achieve an operational capability with the most effective use of the resources and time available. Each of the phases may involve a recycling of effort until the output of the phase is optimized. If appropriate, life cycle phases may be combined or omitted. Some programs, where technology is well developed, may enter the life cycle in mid-stream. Each phase is designed to develop a level of confidence in the solution(s) offered and to reduce the risks involved in proceeding to the next phase. Outputs of each phase constitute a definitive and documented baseline for entry into the next phase. The

life cycle is distinguished by an incremental commitment of resources. As the system evolves, each decision milestone is directed to commitment of increased resources predicated upon the achievement of defined objectives. The milestone objectives are designed to reduce, through demonstrated performance, the risks (cost, technical and schedule) inherent in a new acquisition and provide an information base for decisions to proceed with, redirect, or terminate programs.

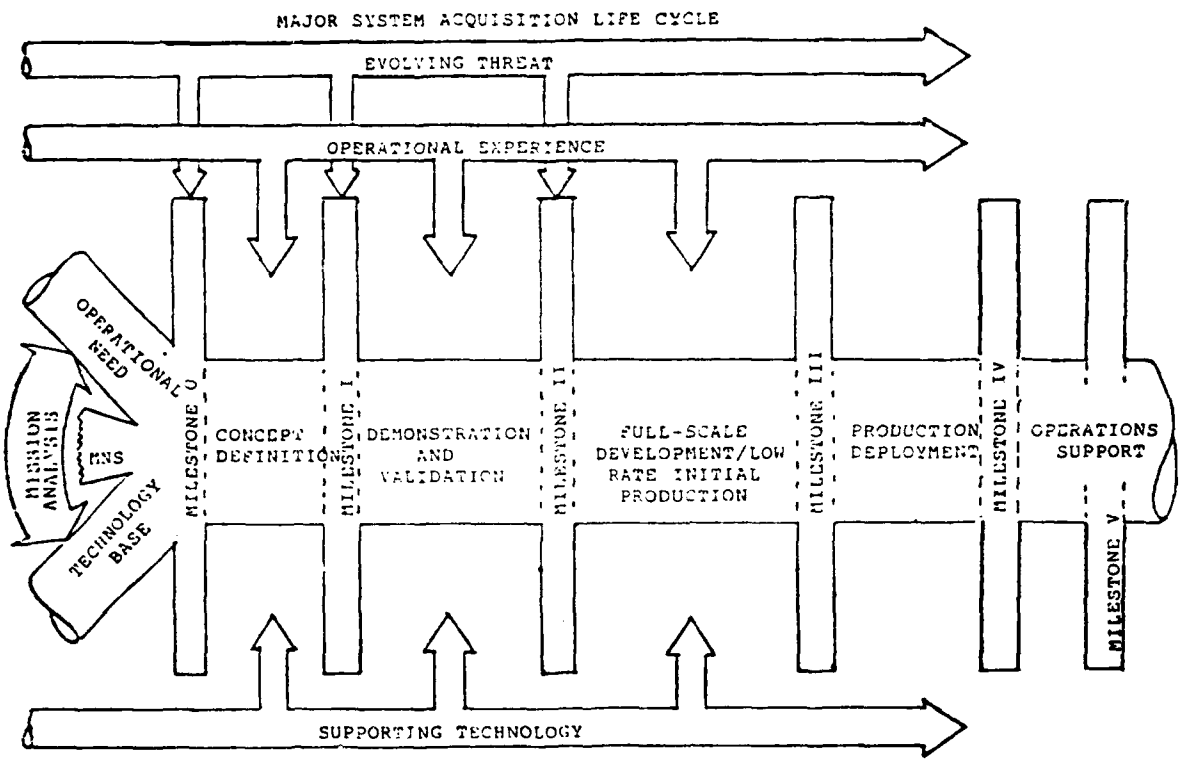


FIGURE 3

Figure 3

Policy for major system acquisitions by DOD components is contained in DOD Directive 5000.1, *Major System Acquisition.* This directive does not attempt to foresee all of the problems which might be encountered and thus provide a solution. Rather, it enunciates guidance the Secretary of Defense expects program managers to follow. For example, note the following excerpts from the directive:

A streamlined acquisition organization . . . will be used. . . .

Military requirements for new acquisitions must be thoroughly reviewed. During this process, trade-offs must be made among performance requirements, cost, and schedule.

Develop acquisition strategies at the inception of each acquisition that sets forth the objectives, resources, management assumptions, prototyping plan , extent of competition, procurement approach, . . .

Assign to the program manager authority and resources commensurate with the responsibility and accountability for executing the program efficiently.

As the above sentences illustrate, DOD Directive 5000.1 is no cookbook to which a PM need refer daily. The idea is to pick good people, tell them their job, and then let them do it. That seems to be a workable philosophy within which motivated people can exercise the management skills they have developed, and feel free to innovate when the opportunity presents itself.

SECTION III
THE OPERATIONAL REQUIREMENTS PROCESS

The operational requirements process provides the means to identify operational deficiencies, state operational needs and initiate development or improvement of systems or equipment. The various Defense Mission Areas or specific missions for which the Air Force is responsible are delegated to the major commands. The Air Force looks to the major commands to continuously analyze their mission capabilities and identify operational needs. Operational needs may result from a projected deficiency or obsolescence in existing systems, a technological opportunity, or an opportunity to reduce cost. The basic principle of the AF operational requirements process, as defined by AFR 57-1, *Operational Needs,* is to encourage and draw upon the ideas and judgment of experienced field personnel. This is accomplished via the coordination and publication of a Statement of Operational Need (*SON*).

Prerequisite to the identification/documentation of operational needs is a comprehensive mission analysis. This analysis must examine the basic mission tasks and assess the command's ability to perform each task in terms of current and projected capability, the present and projected threat, the operational environment, and any other constraints which may limit solutions to identified needs.

The reader should recognize that system developments or improvements also result from recognition that a technological advancement may have mission applications. The scientific community, within the government and throughout the defense contractor world, remains alert to potential applications of discoveries, and constitutes an important source of possible solutions to deficiencies and operational enhancements through technological opportunities.

Operational needs, identified by the analysis process, which cannot be satisfied within the command's existing capabilities and which will likely lead to system or equipment development, should be considered for processing as a SON. The originator of a SON can obtain assistance from the Air Force Systems Command (*AFSC*), Air Force Logistics Command (*AFLC*), and Air Training Command (*ATC*) in conducting mission analyses and preparing SONs. SONs may be submitted by any major command or higher

echelon of the Air Force.

Prior to publishing a SON, the originator is expected to coordinate it in accordance with a comprehensive list directed by AFR 57-1. AFSC, AFLC and ATC will review draft SONs and provide information to the originator concerning the technology base, integrated logistics support, life cycle cost, and safety and training considerations to the extent that information on solutions allows. In the event another major command (*MAJCOM*) proposes to use the end product likely to be developed, that command must offer co-sponsorship of the SON and provide the originator with justification based on its assigned mission

In preparing a SON which documents a need, the originating command must identify the proposed implementing command -- normally AFSC. The implementing will have program management responsibility if it is decided that action will be taken to develop concepts to satisfy that need and that a system development will likely occur.

Since a major factor in the evaluation of anv proposed investment must be the expected cost, a draft Program Decision Package (*PDP*) must accompany the SON. That PDP must identify the funds necessary to begin concept definition and provide a preliminary estimate of the program funds required to pursue the most likely solution to the stated need.

Now the SON faces the HQ USAF validation process (See Figure 4). This is accomplished through a corporate review of the stated need and supporting justification, within the context of total Air Force requirements, objectives, mission, and priorities, and in consideration of resources limitation. Validation of the stated need by the appropriate authority constitutes the Mission Need Determination/Program Initiation decision point of the acquisition process. The appropriate authority is determined predicated upon such factors as the estimated cost, impact on DOD/Allied operational capability, international involvement, political sensitivity, and multiple service involvement. Furthermore, the level of review and approval required to initiate an acquisition program will determine the nature of the documentation required to support such a decision.

Additional documentation, if required to support higher level decisions, is prepared and submitted by the Air Staff.

The Secretary of Defense designates those systems which are to be managed as major systems. That decision may be based upon one or more of the following factors:

--Development risk, urgency of need, or other items of interest to the SECDEF.

--Joint acquisition of a system by the DOD and representative of another nation or by two or more DOD Components.

--The estimated requirement for research, development, test and evaluation (*RDT&E*), and/or procurement funds. The nominal funds threshholds for major systems are: RDT&E-$200 million, procurement-$1 billion (FY 80 dollars).

--The estimated requirement for manpower to operate, maintain, and support the system in the field.

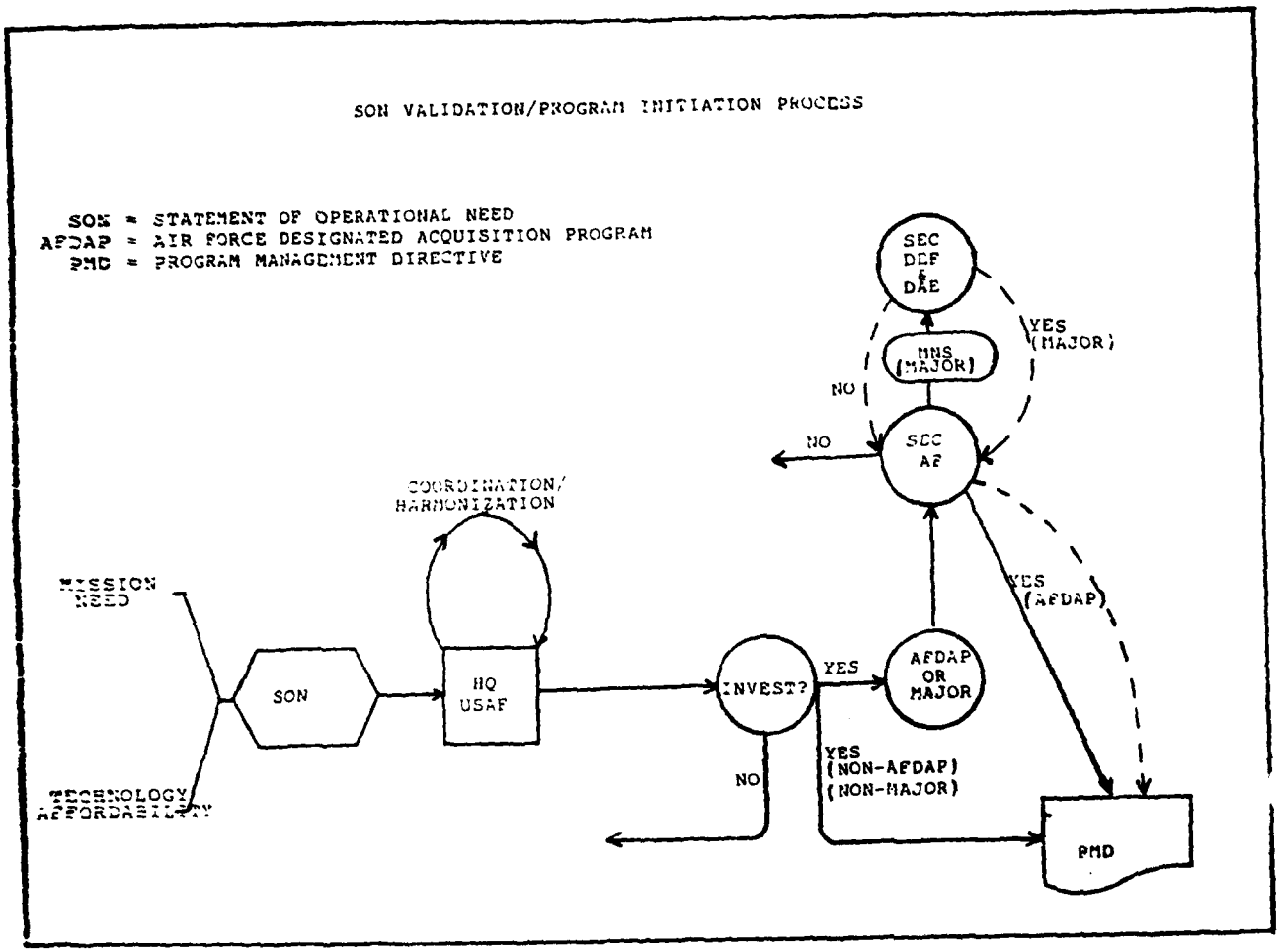


FIGURE 4

Figure 4

--Congressional interest.

The initial need determination for major system acquisitions is made in the planning, programming and budgeting system (*PPBS*) based upon an evaluation of a Mission Need Statement (*MNS*). An MNS is required for all proposed acquisitions for which the service estimates costs will exceed $100 million (FY 80 dollars) in research, development, test and evaluation, and/or $500 million (FY 80 dollars) in procurement funds. The MNS is included as an attachment to the service's Program Objective Memorandum, and inclusion of the system new start in the DOD budget authorizes the service to proceed with concept definition. This authorization may lead to a major system development or to an Air Force Designated Acquisition Program (*AFDAP*). The beginning of the concept definition effort does not depend upon the completion of Congressional action on the DOD budget. Exploratory or advanced development funds are usually available for use at the discretion of the service Secretary and may be provided for the initial

conceptual effort.

Air Force Designated Acquisition Programs are potentially critical programs (but not selected as major programs) which the Secretary of the Air Force has decided warrant his attention at the program decision milestones. That decision will be based upon an assessment of the following criteria:

--Potential resource consumption

--Significant impact on Air Force Capability.

--Technology advancement.

--Other service(s) involvement.

--Political sensitivity.

For AFDAP programs the Secretary of the Air Force will be the decision maker at all of the program milestones. Potential AFDAP programs require a MNS to be submitted with the service's POM.

Potential acquisition programs which do not meet the above criteria, but which are expected to exceed $15 million RDT&E costs or $75 million total costs (RDT&E plus production) will be approved at the Air Staff level. The discussion which follows will describe the acquisition process as it applies to major system acquisition programs; however, the process is similar for AFDAP and other less than major programs; the primary difference is the level of review and approval.

Following MNS approval and a SecAF decision to begin concept exploration, HQ USAF provides formal direction to the implementing and participating commands by using a Program Management Directive (*PMD*). The PMD is used during the entire acquisition life cycle to approve, transfer, modify, or terminate programs.

SECTION IV
THE CONCEPT DEFINITION PHASE

At this point there is a commitment only to identify and explore alternative solutions. This initial approval and establishment of a system acquisition program does not automatically mean that a new system will be acquired. With an approved need, other means of satisfying the need must be analyzed along with the exploration of alternative system solutions. For example: the mission need may be best satisfied by a change in doctrine, by deployment of additional personnel, by increased training, by modifications to existing equipment, by off-the-shelf procurement of a foreign or domestic system already in production, or by a new system acquisition effort.

The initial PMD for a program formally implements the Mission Need Determination Decision. An important element of the PMD which directs the conceptual phase effort is the assignment of the PM and the inclusion of a charter stating his responsibility, authority and accountability for achieving program objectives. The selection of the PM will usually involve key personnel in the Air Staff as well as the Commander of AFSC and his key advisors. At this time AFLC will normally name a senior logistician to become a part of the program office (*PO*) as the Deputy Program Manager for Logistics (*DPML*).

It is incumbent upon the new program manager to develop an acquisition strategy tailored to his particular program. It should address the technical, business and

management aspects of the program and provide a basis for the integration of these areas in achieving program objectives. Initially, the strategy may be limited in content, but it should be expanded and refined as the program progresses. This effort must be closely coordinated with AFLC, ATC and the potential using command if it is to result in a well-ordered, soundly conceived program. The acquisition strategy which results from the coordination effort could typically include: Use of the contracting process, essential achievement milestones, development of test and evaluation criteria, decisions on whom to solicit and content of solicitations, guidelines for the acceptance or rejection of proposals, and methods for appropriate tradeoffs among investment costs, ownership costs, schedules, and performance characteristics.

Business planning for the concept definition phase is a subset of the acquisition strategy and should emphasize competitive exploration of alternatives. Consequently, a solicitation for proposed solutions, in terms of mission need and not of explicit system characteristics, is a key action for this phase.

The vehicle for shaping the contracting process is the Request For Proposal (*RFP*). The RFP is the official document for soliciting effort from potential sources, and it is important that it be structured to support the strategy developed for acquiring the system. In the concept definition phase, it is structured to encourage responses from a broad range of qualified firms and the academic community, and also to emphasize innovation and competition. Therefore, an RFP for a system design concept should provide complete information concerning the mission need or task, the operating environment including threat, schedule and cost goals, and capability objectives,. Each offeror is then free to propose his own technical approach, main design features, and alternatives so that the Government may achieve the benefits of innovation and competition. Offerors should not be constrained by preordained or prematurely selected solutions.

Federal laboratories, federally funded research and development centers, and other not-for-profit organizations are also sources for system design concepts. Ideas, concepts, or technology developed at government expense may be made available to private industry, and industry may incorporate that information in their proposed alternatives. Each of the alternatives must be defined in sufficient conceptual detail so that the basic alternative solutions can be considered in terms of technical, support, operations, and maintenance concepts, as well as the relative life cycle costs.

Each alternative must be evaluated and the *best* selected. In addition to paper analyses and studies, limited experiments and tests may be conducted during this phase to determine the technical feasibility of concepts, defined subsystems, and key components. Even at this early stage, cost estimates must be made for each concept. There must also be an assessment to assure that the solutions proposed will likely be able to counter the defined threat. There would certainly need to be some study to assess how long until each alternative might be ready for operational use.

During the uncertain period of identifying and exploring concepts, contracts which are negotiated will typically cover relatively short time periods at fixed dollar levels. Timely technical reviews will be made to effect the orderly elimination of the least attractive design concepts. Selection of the concepts offering the best potential balance of cost, schedule and technical performance will be made by a team led by the PM. In addition, the use of consultants from outside the Air Force is encouraged to help lend objectivity and to add required technical expertise. The major products of the program office during

this phase will be the planning and management documentation required to support the program review and decision processes prerequisite to entering the Demonstration and Validation phase.

When the competitive exploration of alternative system concepts has been completed to the point where the selected alternative(s) warrant system demonstration, the Secretary of the Air Force will request SECDEF approval (Milestone I, Requirement Validation Decision) to enter into the Demonstration and Validation phase. This recommendation is documented in the System Concept Paper.

The System Concept Paper (*SCP*) is reviewed by the Air Force System Acquisition Review Council (*AFSARC*) followed by the Defense Acquisition Board (*DAB*) prior to the SECDEF decision. That process will be discussed in the next section.

SECTION V
DAB/AFSARC REVIEW PROCESS

The results of the conceptual phase efforts are documented in a System Concept Paper (*SCP*). The SCP is prepared by the program manager and contains an evaluation of the results of the conceptual effort as well as recommendations for a continued acquisition strategy tailored to program needs and goals. As a result of the studies/analyses of design concepts and alternative potential solutions, the SCP should express expected support and operational capabilities and broad cost, operability and performance goals. The SCP provides the primary documentation for use by the DAB in arriving at a Milestone I recommendation. The Milestone I decision is a SECDEF validation of the requirement based upon an evaluation of concepts, costs, and schedule. In the SCP, the program manger will recommend the nature and timing of the next SECDEF decision point, Milestone II, so that a decision to proceed will establish the objectives and goals for the next life cycle phase.

The reader should recognize that this milestone decision period should not put the program on hold and result in a work stoppage while the review and decision process takes place. The PM may not, in fact probably will not, have a complete package or final conceptual studies to present at Milestone I. There will likely be conceptual studies and analyses still in progress. Milestone I should be scheduled when there is sufficient information and evidence to support a recommendation either that the program proceed into the next phase of the life cycle with a demonstration/validation of one or more proposed solutions or that the program be discontinued.

If a decision to proceed is made, the PM should conclude any studies still in progress and move rapidly into the demonstration/validation phase. If the decision is to discontinue the program, the PM should terminate his conceptual studies to minimize costs.

The DAB (see Figure 5) serves as an advisory body to the SECDEF for major system acquisitions and provides supporting information and recommendations when decisions are necessary. The DAB has the responsibility to review such major system acquisition issues as the Defense Acquisition Executive (*DAE*) determines to be necessary. The DAE is the principal official to whom the SECDEF looks for the development and implementation of acquisition policy and for advice during the acquisition decision process. He is the chairman of and spokesman for the DAB. Following each milestone review, the

DAB will usually recommend that the SECDEF either (1) approve the next phase, (2) order the Air Force to conduct further studies, or (3) discontinue the program. In addition, the DAB may be convened at any time to review a program that has encountered significant problems which indicate the SECDEF should review its status. DAB reviews are a means to evaluate information necessary to the SECDEF for decisions specifically reserved to him. They are not to be used to request data other than those required for these decisions.

DEFENSE ACQUISITION BOARD (DAB)

CHAIRMAN:
USD (ACQUISITION) (DEFENSE ACQUISITION EXECUTIVE)

MEMBERS:
VICE-CHAIRMAN, JCS
ASD (C)
ASD (P&L)
DIRECTOR (OT&E)
DIRECTOR (PO)
SERVICE ACQUISITION EXECUTIVE
PRINCIPAL DEPUTY To USD (A)
DIRECTOR (Appropriate Committee)

Figure 5.

The decision reached at each of the review points includes a description of the system in terms of its expected capabilities; specific cost, schedule, and performance goals to be accomplished during the next life cycle phase; general acquisition strategy; and any other factors the DAE considers critical to the program's success. This description becomes a formal agreement -- almost a contract -- between the DAE and the PM, which may only be changed with the DAE's concurrence. The *contract* is formally known as the Program Baseline.

The AFSARC was first chartered in June 1976 by the Secretary of the Air Force in accordance with DOD Directive 5000.1 and is similar in composition, responsibilities and operation to the DAB (see Air Force Regulation 800-2). Its purpose is to serve as an advisory body to the Secretary of the Air Force and through him to the SECDEF on major system acquisitions and to provide information and recommendations in support of decisions as necessary. The AFSARC reports to the Secretary of the Air Force. Occasionally the Defense Acquisition Executive may decide that the AFSARC review and findings are sufficient and waive the DAB review for a major system. For Air Force Designated Acquisition Programs (*AFDAP*) the Secretary of the Air Force decision will establish the approved program and authorize beginning the subsequent phase of the acquisition life cycle.

The AFSARC reviews all major system acquisition programs at Milestones I, II, III, IV, and V. (see Figure 3 [See above]). Formal DAB reviews are also normally held at Milestones I, II, III, IV, and V. In addition, any DOD component head or DAB member may request the DAE, at any point in the acquisition process, to schedule a DAB meeting to consider significant issues..

If the DAB and/or AFSARC (when a DAB review is not required) conclude that the review does describe a prospective system for which a true mission need exists and for which the technical, military, and economic bases can be sufficiently well established, they will recommend that the SECDEF approve the transition of the program to the next phase. If the SECDEF concurs with the recommendation, he will approve the SCP and issue an Acquisition Decision Memorandum (*ADM*), thus reaffirming the mission need and approving one or more selected alternatives for competitive demonstration/validation.

The ADM documents the SECDEF's milestone decision including approval of goals and thresholds for cost, schedule, performance and supportability against which the program must be managed and will be evaluated. At each milestone additional threshold values are established and documented to reflect allowable variances from the approved point estimates. Since such thresholds represent operating limitations for the program manger, any time they are exceeded, or are expected to be exceeded, the program will normally be subject to review.

SECTION VI
THE DEMONSTRATION AND VALIDATION PHASE

Subsequent to SECDEF approval to proceed with the demonstration/validation effort and upon receipt of the ADM, a revised PMD is prepared by HQ USAF to: transmit the "go ahead" to the implementing command, normally AFSC; enumerate the roles of the participating organizations; identify resources; specify constraints; and delineate required tasks. With the PMD in hand, AFSC will augment the SPO as necessary/ practical and commence the Demonstration and Validation phase.

In the Demonstration and Validation phase, definitization of the selected alternative(s) is expanded, and the value and practicality of the increasingly specific design approach continues to be checked. The definitization work is typically carried out in one of three ways: (1) primary system hardware prototyping, (2) *paper* studies, or (3) paper definition plus subsystem prototyping. Whichever way is chosen, the central thrust of the effort during this phase is the reduction of technical risk and economic uncertainty through a more detailed definition of the new system. This definitization work is commonly done by defense contractors under SPO direction.

The approach to the demonstration/validation effort currently preferred is to select at least two contractors to build prototypes which are to be evaluated during the latter days of this phase. There are at least two major payoffs in this dual contractor approach. One is that we can maintain competition longer in the acquisition -- which tends to supply a better product at the best price. The other is that we have a much better data base for our development decision after seeing and evaluating alternate design approaches as they are translated into hardware.

It should be noted that the prototype approach to demonstration/validation is concerned with fabrication of a system resembling the operational system only to the extent that performance objectives can be validated.

The *paper* studies approach to demonstration/validation emphasizes the competition of two or more defense contractors, utilizing studies and analyses, in an attempt to define and refine the system. The decision as to which contractor(s) will receive awards for full-scale development will depend upon careful, detailed evaluation of the competing proposals.

The selection of the most practical approach must be based upon risks, tradeoffs, availability of competition, and program resources. For some very large, sophisticated systems the cost of the full prototype approach to demonstration/validation could be prohibitive. A compromise solution may be to select a prime contractor based upon a rigorous source selection evaluation of competitive designs, and then prototype those subsystems which are expected to offer the greatest technical risk.

The total effort of the Demonstration and Validation Phase is evaluated in preparation for the Milestone II, Program Go-Ahead Decision as once again the program enters the AFSARC/DAB process. Primary program review documents are now the Decision Coordinating Paper and the Integrated Program Summary (*DCP* and *IPS*). The DCP and IPS summarize the Air Force acquisition plan for the system's life-cycle and provide a management overview of the program. They will include essential program information such as: need/threat, design concept, supportability, operability, issues and risks, and affordability in terms of projected budget and phasing of out-year funding. The DCP is an 18-page document which is oriented primarily to a summarization of program progress to date and the plan for accomplishing the next life-cycle phase. The IPS is a 30 page paper which takes a broader view to include progress toward ensuring an operational capability and the planning for support and organizational factors. The AFSARC and DAB review the program to ensure that the need still exists, and that procurement methods, contract form, management systems, etc., match the job to be done, its goals, risks and uncertainties. Their recommendation to the Secretary of the Air Force and Secretary of Defense depends heavily upon their evaluation of how well the Air Force has defined the technical, financial, and schedule factors of the program. The results of the Milestone II review will be transmitted to the Air Force by an Acquisition Decision Memorandum. This decision, in addition to being a commitment to continue the program through engineering development, includes a commitment to acquire long-lead procurement items and to perform low rate initial production (*LRIP*) to support initial operational testing. It should occur when there is sufficient evidence to support a decision that a satisfactory solution has been demonstrated and validated. This does not assume that there are no risks or uncertainties remaining. There should, however, be a high level of confidence that the remaining technical, cost, and schedule risks have been identified and that they can be resolved within program resource and time constraints. If the decision is to continue, the program will enter Full-Scale Development/Low Rate Initial Production.

SECTION VII
THE FULL-SCALE DEVELOPMENT/LOW RATE INITIAL PRODUCTION PHASE

Following the milestone II decision, quarterly program reviews are conducted by the Secretary of the Air Force and key program issues reported to the SECDEF and the Defense Acquisition Executive.

During this phase (the third of the life cycle), the system, including all essential support equipment and documentation, is designed, developed, fabricated, and tested. The intended output is a pre-production prototype and includes the documentation needed to produce the system for the operational inventory. To accomplish this, it is necessary to complete the engineering design and demonstrate the adequacy of the design via a formalized and comprehensive full system test effort.

By the end of this phase, detailed design specifications will be finalized and engineering drawings prepared which become the basis for buying force structure quantities of system units during the production phase. The fabrication of developmental hardware is a major effort during this phase. In support of that effort, the proposed design is examined in great detail during preliminary design reviews. Before hardware fabrication is authorized, the Program Office and support personnel become involved in review(s) of mockups for the proposed equipment to assure that the configurations are in accordance with the initial design requirements. Finally, critical design review(s) is (are) held, which is the last official chance to comment on the developing design before commitment to accept that design.

Testing is a vital ingredient in a successful FSD program. It is through test and evaluation, conducted by the contractors and by the Air Force, that the technical and engineering problems that need to be solved are identified and the resulting design fixes demonstrated. System testing starts with the development of early plans for testing the components in the system. The impact of various aspects of testing becomes increasingly significant as each configuration item (*CI*) proceeds through development testing. The testing process reaches a high degree of detail in subsystem testing and finally full system testing which includes the support elements of the system.

The primary purpose of test and evaluation (*T&E*) during the acquisition process is the reduction of risk, either the risk that the system or equipment will not meet performance specifications or the risk that the system or equipment cannot be effectively employed in its intended operational environment. Furthermore, T&E is the primary means by which achievement of program objectives is demonstrated to justify continuing or increasing the commitment of resources to acquisition programs.

There are basically two types of testing associated with acquisition programs: Development Test and Evaluation (*DT&E*) and Operational Test and Evaluation (*OT&E*). OT&E, in the USAF environment, is further differentiated by identifying OT&E accomplished prior to the Milestone III/Production Decision as Initial Operational Test and Evaluation (*IOT&E*). (See Figure 6).

The purpose of DT&E is to:

--Demonstrate that engineering design and development are complete,

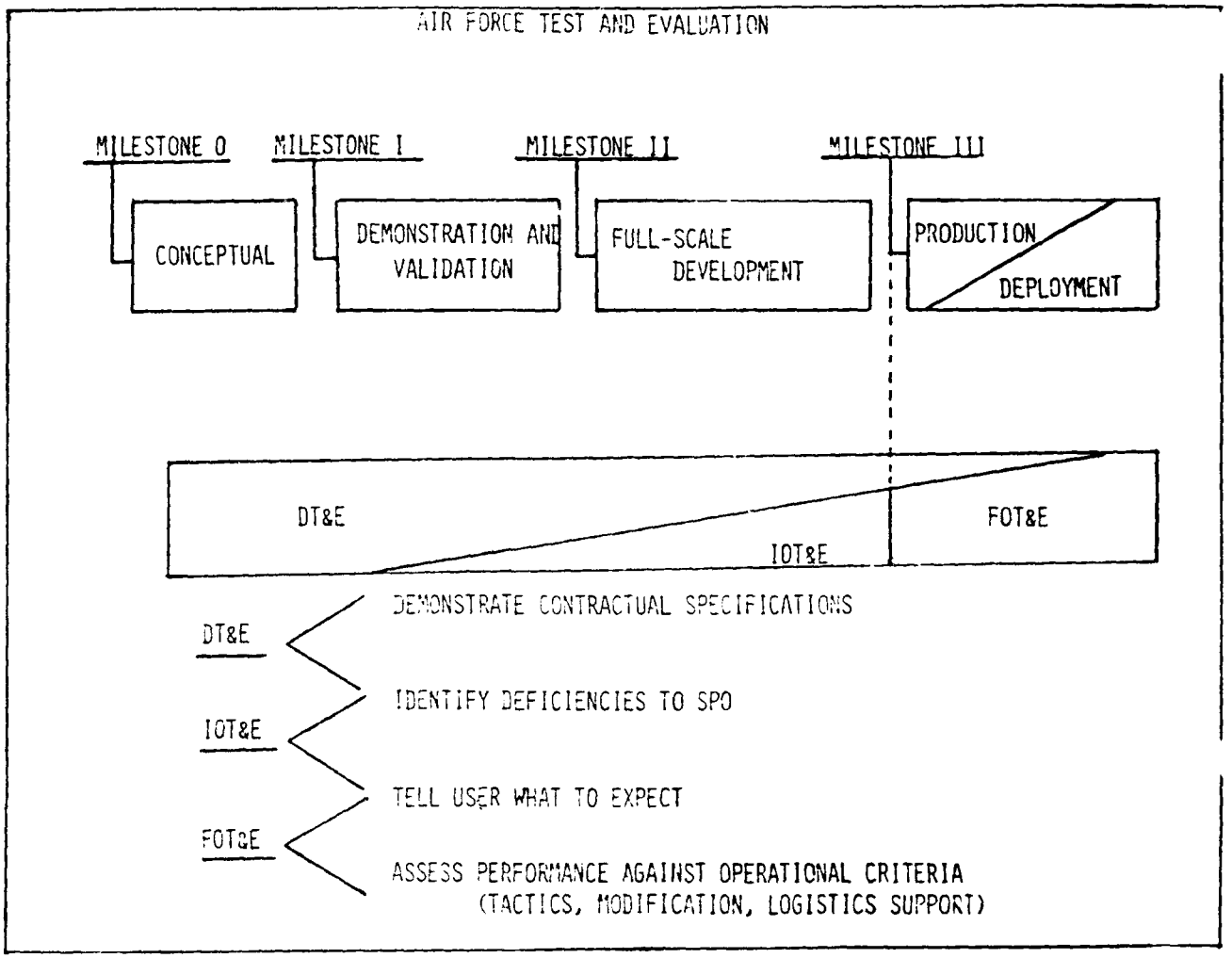


FIGURE 6

--Minimize design risk,

--Demonstrate that the system or equipment meets specifications, and

--Verify that proposed design changes do not degrade overall system performance.

DT&E is essentially a detailed engineering analysis of system performance when design of the system is tested and evaluated against engineering and performance criteria (normally derived from the system specification) by the implementing command.

OT&E is conducted to:

--Estimate military utility, operational effectiveness and suitability,

--Provide feedback prior to key milestone decisions,

--Demonstrate that the system can be supported logistically in a deployment status,

--Identify new uses for the system, and

--Reshape tactics,

OT&E is essentially an operational assessment during which the system is evaluated against operational criteria by personnel with the same qualifications as those who will eventually operate, maintain, and support the system when it is deployed. The role of T&E is stated in DODI 5000.3 as follows:

> *Test and evaluation shall begin as early as possible and be conducted throughout the system acquisition process to assess and reduce acquisition risks and to estimate the operational effectiveness and operational suitability of the system being developed . . . Successful accomplishment of T&E objectives will be a key requirement for decisions to commit significant additional resources to a program or to advance it from one acquisition phase to another.*

Frequently the desire to maintain program continuity and pressure to meet established initial operational capability commitments dictate a decision to begin a low rate initial production program before the full demonstration of design stability. This overlapping of the FSD and production phases, called *concurrency*, involves the acceptance of certain risks. Since system testing will not have been completed before the *low rate* production process begins, there will almost certainly be test failures which may lead to design revisions and the necessity to incorporate changes in the production process or in delivered prime mission equipment. The effect of those changes may ripple across support equipment, data, simulators, training programs, etc. On the other hand, the more closely items for initial operational testing resemble the final production configuration, the sooner a stable production process can be established. Clearly decisions as to how much concurrency to incorporate into the acquisition strategy must be made carefully so that the expected benefits outweigh the potential risks. The more mature the system technology and the more stable the design the less hazardous is a decision to use concurrency. Current policy requires a Low Rate Initial Production Report be provided to the Secretary of Defense, and the Congress before the ADM is signed to authorize Full Rate Production/Deployment. The LRIP Report is an assessment of the adequacy of the test results and of the effectiveness and suitability of the system for combat.

Milestone III approval by the SECDEF constitutes the production/deployment decision, which is documented in an ADM and implemented by a revision to the PMD. That decision to produce for operational use defines the initial quantity to be produced, and approves plans for future production and deployment. If no significant changes have occurred affecting the system during the FSD/LRIP phase (i.e., major design change, large increase in costs, change in contractual approach, etc.) the decision for production may be delegated to the individual service secretary.

SECTION VIII
THE PRODUCTION/DEPLOYMENT AND OPERATIONS SUPPORT PHASES

The actual commitment to production is formally and contractually accomplished at the onset of the Production Phase. During this phase, the system, including training equipment, spares, facilities, etc., is produced for operational use. All verification of hardware compliance with final specification requirements is usually completed no later than this phase. Any decisions deferred from FSD/LRIP regarding support areas such as

maintenance, logistic support, and training must now be settled. Production management systems for control of the factors of production, quality and finished product inventory are applied.

Tests begun during FSD/LRIP are continued during the Production/Deployment Phase. System elements are integrated into a complete system in as near an operational configuration as possible. Contractor participation in testing is not complete until system performance specification requirements are met.

It is also during this phase that program management responsibility transfer (*PMRT*) occurs. PMRT is the formal act of transferring program management responsibility for a system or equipment from AFSC to AFLC. PMRT includes transfer of engineering responsibilities. The date for PMRT is determined by negotiations between the implementing and supporting commands during the FSD/LRIP Phase and forwarded to HQ USAF for inclusion in the production PMD. PMRT will occur at the earliest practicable date during the Production/Deployment Phase. Once established, the date will not be changed without the concurrence of HQ USAF.

Finally, the system nears the end of the acquisition process and arrives at the threshold of operational use -- deployment. The Secretary of the Air Force decides that the system is ready to be deployed to the using command(s) and advises the SECDEF of his decision.

Deployment begins when production items are provided to and used by operational units. Turnover to the using command is effected.

Turnover is the formal act whereby the using command accepts responsibility for the operation and maintenance of the first operating units of a new system, and assumes property accountability. This point in the life cycle is normally identified as initial operational capability (*IOC*). The using command continues operational tests to develop the most effective operational tactics, techniques, and standards.

Some time following initial deployment there will be another review (Milestone IV). This review marks the beginning of the Operations Support Phase, and the system will remain in this phase until its retirement from the active inventory. The time for the Milestone IV review will be established by the DAE and will depend on factors such as the success of the production models, the state of technology advances, the achievement of supportability goals, and system readiness. All of these things will be reviewed so that decisions may be made regarding improvements which may be indicated to ensure the system's continued capability to perform the mission for which it was acquired. If the system, based upon operational performance and support experience, is failing to achieve contractually required standards, then the Air Force will determine if adequate warranties exist and if they may be exercised for the correction of the deficiencies.

The Milestone V review and decisions will focus on the system's operational effectiveness, suitability, and readiness. If the system is operating as required but still falls short of meeting current needs, then consideration may be given to initiating either a modification program to enhance the system's capability, or a program to develop a replacement system. Once again the pivotal role of mission analysis is clear. System development begins and is sustained because a demonstrated need exists and is continually evolving. Existing systems are evaluated and keep changing because mission analysis keeps us in touch with the constant growth and changing nature of the

--Identify new uses for the system, and

--Reshape tactics,

OT&E is essentially an operational assessment during which the system is evaluated against operational criteria by personnel with the same qualifications as those who will eventually operate, maintain, and support the system when it is deployed. The role of T&E is stated in DODI 5000.3 as follows:

> *Test and evaluation shall begin as early as possible and be conducted throughout the system acquisition process to assess and reduce acquisition risks and to estimate the operational effectiveness and operational suitability of the system being developed . . . Successful accomplishment of T&E objectives will be a key requirement for decisions to commit significant additional resources to a program or to advance it from one acquisition phase to another.*

Frequently the desire to maintain program continuity and pressure to meet established initial operational capability commitments dictate a decision to begin a low rate initial production program before the full demonstration of design stability. This overlapping of the FSD and production phases, called *concurrency*, involves the acceptance of certain risks. Since system testing will not have been completed before the *low rate* production process begins, there will almost certainly be test failures which may lead to design revisions and the necessity to incorporate changes in the production process or in delivered prime mission equipment. The effect of those changes may ripple across support equipment, data, simulators, training programs, etc. On the other hand, the more closely items for initial operational testing resemble the final production configuration, the sooner a stable production process can be established. Clearly decisions as to how much concurrency to incorporate into the acquisition strategy must be made carefully so that the expected benefits outweigh the potential risks. The more mature the system technology and the more stable the design the less hazardous is a decision to use concurrency. Current policy requires a Low Rate Initial Production Report be provided to the Secretary of Defense, and the Congress before the ADM is signed to authorize Full Rate Production/Deployment. The LRIP Report is an assessment of the adequacy of the test results and of the effectiveness and suitability of the system for combat.

Milestone III approval by the SECDEF constitutes the production/deployment decision, which is documented in an ADM and implemented by a revision to the PMD. That decision to produce for operational use defines the initial quantity to be produced, and approves plans for future production and deployment. If no significant changes have occurred affecting the system during the FSD/LRIP phase (i.e., major design change, large increase in costs, change in contractual approach, etc.) the decision for production may be delegated to the individual service secretary.

SECTION VIII
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The actual commitment to production is formally and contractually accomplished at the onset of the Production Phase. During this phase, the system, including training equipment, spares, facilities, etc., is produced for operational use. All verification of hardware compliance with final specification requirements is usually completed no later than this phase. Any decisions deferred from FSD/LRIP regarding support areas such as

challenges to successful mission accomplishment. New system developments begin when technology and operational needs dictate.

SECTION IX
CONCLUSION

Having described the typical system acquisition life cycle for a major system, one is led almost inevitably to this caveat -- there is no fixed, well-lighted, clearly marked highway from a *deficiency* to an operational capability. Because of groundwork laid by laboratories or work on similar systems, a program could begin at any milestone in the life cycle or in the middle of any life cycle phase. Because of unforeseen developments, uncertainties, or mission changes, a program could conceivably be required to redo a phase. Because every program faces a formal review process between its life cycle phases, and/or when any DCP threshold is breached, every program is in periodic jeopardy of cancellation.

Consequently, the system acquisition process or cycle must be flexible, and in fact is deliberately so, in order to be responsive to the truth that every system development is unique. But the guidance is there, enunciated clearly enough to tell any program manager what he is expected to achieve and demonstrate. Achievement and demonstration are the keys. The SECDEF will not give any service a blank check based upon proof of an operational deficiency. The acquisition management process is designed to allow him to periodically review both the requirement and progress toward its fulfillment, and to commit resources incrementally after the demonstrated achievement of program milestones. However, the incremental commitment of resources will only be adequate to reach the next major milestone. The DOD, like any other consumer on a budget, intends to buy only what it needs and only when satisfied that the product will do the job.

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OPERATIONAL REQUIREMENTS PROCESS

The operational requirements process is a structural process of analysis and iterative refinement by which HQ USAF, major commands (*MAJCOM*) and Separate Operating Agencies (*SOA*) can document operational deficiencies and needs for validation and solution. The process is structured to ensure that each operational deficiency that is not within command solution authority can be documented, coordinated, validated, compared to competing deficiencies, and solved through acquisition programs. The process begins with the identification of operational needs and continues throughout the acquisition process and the life of the system. It provides for systematic updates to ensure that the proposed solution will meet evolving needs.

Success of the operational requirements process demands a close, continuing relationship among operating, implementing, supporting, operational test, and other participating commands. A major element of the requirements process is the continual identification of meaningful performance tradeoffs whereby high-cost features providing only marginal performance gains are deleted from the system. Incorporated in this process are numerous key documents. Though most of them will be mentioned, this description will be limited predominantly to the Statement of Operational Need (*SON*), System Operational Requirements Document (*SORD*), and the Depot Support Requirements Document (*DSRD*).

Statement of Operational Need (*SON*):

A SON is required for needs that cannot be met through changes in tactics, strategy, doctrine, or training and whose solution requires a new development or upgrade of an existing system. It describes each need in operational terms and has three principal uses: It defines an operational need, documents official validation of the need, and furnishes preliminary requirements for RDT&E planning (see attachment 1 for SON format).

A validated SON is required for a program to compete for funding and is a prerequisite for HQ USAF preparation of a Mission Need Statement (*MNS*) or Air Force participation in a Joint System Operational Requirement (*JSOR*). A SON is required for all programs that involve RDT&E (3600) and/or procurement (3010, 3020, 3080) funding except for some low-cost class V modifications and communication computer systems.

SON Validation: Operating commands must address any additional or revised programmatic data and resolve major issues. Any programmatic changes will be coordinated with the implementing command. Resolution of issues and comments should be kept on file by the operating command. The operating command then validates and publishes the revised SON with its draft Program Decision Package (*PDP*). The validated SON is signed by the MAJCOM commander or designated representative. Multicommand SONs will be signed by the lead command with written concurrence by the co-sponsoring commands.

Programming and Budgeting for Validated Needs:

All Program Decision Packages (*PDPs*) that require funding, through the procurement or RDT&E appropriations must be in response to validated SONs. The HQ USAF Office of Primary Responsibility (*OPR*) must prepare a MNS for each PDP expected to lead to acquisition of a major system or to an Air Force Designated

Acquisition Program (*AFDAP*). The MNS must be submitted formally as an attachment to the Air Force Program Objective Memorandum (*POM*). HQ USAF will issue a Program Management Directive (*PMD*) to implement approved programs for which resources are identified in the OSD-approved Five-Year Defense Program (*FYDP*).

System Operational Requirements Document (*SORD*):

The operating command will submit a SORD, as per PMD direction, for each funded program initiated by a SON, MNS or JSOR. (See attachment 2 for SORD format). During the early part of the Concept Exploration/Definition phase, a SORD will be developed by the operating command(s) for approval, prior to Milestone I. As the program matures, the SORD will be updated, refined and approved prior to Milestone II and again at Milestone III.

The SORD is the requirements and planning document prepared to address operational and support needs. Commands, agencies and Air Staff offices use the SORD to identify, assess and verify the adequacy, accuracy, and completeness of requirements, program factors, and planning considerations. The SORD amplifies and refines the content of the SON and, therefore, must be developed in close coordination with the implementing command to ensure all major issues are resolved prior to SORD approval. The SORD further explains how the proposed system will be operated, deployed, employed and supported. It assists development planning by documenting the cost/performance tradeoffs conducted as the concepts evolve. It also assists in scoping the set of specifications that will be incorporated in the Request for Proposal (*RFP*), serves as the basis for requirements in subsequent program, test and management plans, and documents evolving operational requirements which may be changing due to cost/performance tradeoffs or evolution in the threat.

Depot Support Requirements Document (*DSRD*):

The DSRD is a stand-alone document prepared by the PMD designated supporting command (see attachment 3 for DSRD format). It is an adjunct to and complements the SORD. It describes the supporting command's plans and requirements for providing both depot maintenance and material support to the system described in the SORD. Normally the implementing PMD will initiate development of a SORD and DSRD simultaneously.

SON FORMAT (atch 1)

I. *Mission.*

A. Mission Area: Identify primary and any related mission areas in which the need exists.

B. Mission Element Need: State the need in terms of the requirement to perform one or more military tasks having certain described characteristics -- not in terms of system performance.

C. Joint Service/Multinational Applicability: self-explanatory.

II. *Basis of Need*: Identify and describe the basis of need (i.e., change in enemy threat, deficiency in existing systems, technological opportunity, expanded mission, etc.)

III. *Assessment of Capabilities*: Briefly summarize and assess the existing and planned DOD and allied capabilities for performing the military task(s) described in

para. IB.

IV. *Needed Capability*:

A. General Operational Requirement: Briefly describe the essential qualitative and quantitative requirements that are necessary for accomplishment of the previously identified military tasks.

B. Possible Solution(s): Describe alternatives under consideration.

1. Upgrades to existing/off-the-shelf systems.

2. New System.

V. *Proposed Program*: (normally AFSC input)

A. Acquisition Strategy: Describe the basic program strategies, such as: program structure, competition, contracting, OT&E. This provides underlying rationale for the schedule and funding profiles.

B. Schedule: For major and AFDAP program, include a schedule that shows key events in concept exploration and an initial estimate of milestone II & III and Initial Operational Capability (*IOC*).

C. Funding Profile: Include as an attachment the PDP that was submitted in the POM as well as the implementing and supporting commands estimated funding profile for the most likely solution and associated assumptions.

SORD FORMAT (atch 2)

I. *Mission:*

A. Mission Area: Same as is in the SON.

B. Mission Element Need: Same as is in the SON.

C. Joint Service/Multinational Applicability: Same as is in the SON.

II. *Basis of Need*: Same as is in the SON.

III. *Assessment of Capabilities*: Same as is in the SON.

IV. *Proposed Operational System*:

A. System Description: Self-explanatory

B. Required System Performance: Specify quantitative values for operational and logistics support performance parameters.

C. Readiness Requirements: Identify quantitative and qualitative readiness requirements to reflect reliability and maintainability goals. As a minimum, the following parameters will be described:

1. System Readiness: Operational availability and sustainability requirements.

2. Reliability:

a. Mission Reliability.

b. Logistics Reliability.

3. Maintainability.

D. System Survivability: Show self-protection capabilities, system design or performance required for enhanced survivability.

E. Preplanned Product Improvement (*P3I*): Describe provisions or implication for future system growth.

F. Deferred System Enhancements: If required, show enhancements that are currently not approved or funded but would, if incorporated, materially affect the overall design, development or operational capability.

G. *Employment.*

1. General Employment Description.
2. Mission Scenario and Tactics.
3. Force Structure.
4. Command & Control Structure.
5. Information Systems.
6. Operational Environment.
7. Environmental Assessment.
8. Operational Intelligence Support.
9. Mapping, Charting, & Geodesy.
10. Unique Weather Support Requirements.

H. Deployment.

1. Basing.
2. Mobility.
3. Support Structure Survivability.

I. Support.

1. Maintenance Planning.
2. Manpower & Support.
   a. Manpower.
   b. Personnel.
   c. Human Factors.
   d. Supply Support.

J. Related Support Factors.

1. Information System Support.
2. Logistics Support Management Information.

K. Support Equipment.

L. Technical Data.

M. Training & Training Support.

1. Training Agencies.
2. Anticipated Training Equipment.
3. Trained Personnel Required.

N. Computer Resources Support.

1. Design & Development Constraints.
2. Computer Hardware & Software.
3. Security.

O. Facilities.

P. Packaging, Handling, Storage, and Transportation.

Q. Miscellaneous:

1. Energy Management.
2. Survivability.
3. Standardization, Interoperability, and Commonality.

V. *Program Data*:

A. Program Management Directive.

B. Requirements Documents.

C. Program Status & Schedule.

D. Planned Test Strategy.

E. Safety.

F. Programmatic Data.

G. Level of Dissemination.

H. Security Protection for Systems & Sites.

I. Threat Assessment.

J. Requirements Correlation Matrix (*RCM*): This is a separate attachment to the SORD.

DEPOT SUPPORT REQUIREMENTS DOCUMENT (DSRD) FORMAT
(atch 3)

I. *Program Data*:

a. Title

b. Point of Contact

c. Requirements Document

d. Program Management Directive (*PMD*)

e. System Description

II. *Depot Maintenance Concept*:

a. Maintenance Tasks

b. Base Planning

c. Test and Fault Isolation

d. Modular Automatic Test Equipment

e. Depot Repair

f. Technical Data

g. Depot Training
h. Depot Facilities

III. *Material Support Concept*:
a. Hardware Support
(1) Engineering Data Requirement
(2) Technical Orders
(3) Configuration Control
(4) Force Management
(5) Integrated Diagnostics Concept
b. Software and Firmware Support
(1) Software Partitioning
(2) Integrated Software Support Facility
(3) Software validation and Verification
(4) Software Documentation
c. Spares Support
d. Warranties and Guarantees
e. Data Systems
f. Material Management Training Requirements
g. Material Management Facility Requirements

IV. *Miscellaneous*: To be determined, based on program requirements.

LESSON ONE

ACQUISITION PROGRAM

AFR 800-2

DIRECTED EFFORT FUNDED THROUGH:

1. PROCUREMENT APPROPRIATIONS
2. SECURITY ASSISTANCE PROGRAM; OR
3. RESEARCH, DEVELOPMENT, TEST AND EVALUATION APPROPRIATIONS

PROVIDES A NEW OR IMPROVED CAPABILITY FOR A VALIDATED NEED.

INCLUDES MISSION RELATED EQUIPMENT AS WELL AS SUPPORTING EQUIPMENT, SYSTEMS, PROJECTS AND STUDIES.

TYPES OF FUNDS

PROCUREMENT - 3010 - AIRCRAFT

3020 - MISSILE

3080 - OTHER PROCUREMENT

RESEARCH, DEVELOPMENT, TEST AND EVALUATION - 3600

MILITARY CONSTRUCTION - 3300

OPERATIONS AND MAINTENANCE - 3400

***

DIRECTED EFFORT

PROGRAM MANAGEMENT DIRECTIVE (PMD)

- HQ USAF TO MAJOR COMMAND

AFSC FORM 56

- HQ AFSC TO PRODUCT DIVISIONS

PROGRAM ACTION DIRECTIVE (PAD)

- HQ AFLC TO CENTERS

PURCHASE REQUEST (PR)

- ANYBODY TO PROGRAM MANAGER

VALIDATED NEED

0 OPERATING COMMAND ANALYZES CAPABILITY TO MISSION BASED ON:

* CURRENT CAPABILITY

* THREAT ANALYSIS

0 IDENTIFIED DEFICIENCIES ARE DOCUMENTED IN STATEMENT OF OPERATIONAL NEED (SON)

0 SON COORDINATED WITH OTHER COMMANDS

***

SYSTEM

INCLUDES MISSION EQUIPMENT AND ALL SUPPORT REQUIRED FOR OPERATIONS AND MAINTENANCE SUCH AS:

SUPPORT EQUIPMENT	TRAINING
TRAINING EQUIPMENT	SPARES
PERSONNEL	PACKAGING
TECHNICAL ORDERS	FACILITIES

CATEGORIES OF AIR FORCE ACQUISITION PROGRAMS

- 0 DOD MAJOR PROGRAMS
- 0 AIR FORCE DESIGNATED ACQUISITION PROGRAMS
- 0 NON-MAJOR PROGRAMS

***

DOD MAJOR PROGRAM CRITERIA

- 0 RESOURCES
  - $ 200M IN RDT&E
  - $ 1B IN PRODUCTION
- 0 RISK OR URGENCY
- 0 JOINT SERVICE USAGE
- 0 CONGRESSIONAL INTERESTS

AIR FORCE DESIGNATED ACQUISITION PROGRAM CRITERIA

0 RESOURCES

$100-200M IN RDT&E

$500M-$1B IN PRODUCTION

0 RISK OR URGENCY

0 OUTSIDE INTEREST

***

NON-MAJOR PROGRAM CRITERIA

0 RESOURCES

< $100M IN RDT&E

< $500M IN PRODUCTION

0 NOT DESIGNATED AS DOD MAJOR OR AIR FORCE DESIGNATED PROGRAM

LESSON 2

LESSON TITLE: **Internal Program Management**

TIME: 1 hr

LESSON OBJECTIVE: The objective of this lesson is for each student to know the types of internal organizations available to program managers, the advantages and disadvantages of each kind of organization, and the functions normally found in a program office.

SAMPLES OF BEHAVIOR: Each student will be able to:

a. Describe the advantages and disadvantages of a *functional* type organization.

b. Describe the advantages and disadvantages of a *project* type organization.

c. Describe the advantages and disadvantages of a *matrix* type organization.

d. State the environment for which the *project* type organization is best suited.

e. State the environment for which the *functional* type organization is best suited.

f. Describe the functional specialties normally found in an Air Force program office.

TOPIC INTRODUCTION:

Now that you understand what the system concept is, you need to understand how human resources are typically organized to bring that weapon system to fruition. Organizations are typically organized along functional, project, or matrix lines. The type of organization you are working in depends on where you work (i.e., Air Force Systems Command or Strategic Air Command, as examples). Some organize along functional lines of authority (as in the early 1960s), some along project lines (like at most laboratories), and some along matrix lines (like at several product divisions). One of the first issues addressed should be what type of organization is pertinent to your program and how does this affect your management style? The type of organizational structure probably will depend on the policies of the local base, the mission need you are fulfilling, and, ideally, the method that you determine is the most efficient and effective structure. Normally, the program manager has to live with the organizational structure that is set by policy, superiors, or availability of resources. Either way, a program manager needs to understand the advantages and disadvantages of each type of organizational structure in order to maximize a given situation. This lesson describes the three types of organizations, the advantages and disadvantages of each, and how this affects program management. Think about organizational structures in terms of your own experiences and what would be best for meeting your acquisition requirements. As program manager, you need to understand the capabilities and limitations of your subordinates, peers, and superiors in managing acquisition programs.

METHOD OF INSTRUCTION: Lecture/Discussion

INSTRUCTIONAL MATERIALS:

a. Article, *Matrix Management: Is it Right for Weapons Acquisition?*, by Dr Patterson, DSMC Program Manager's Newsletter

b. *Internal Management* videotape

c. Lesson viewgraphs

AUDIO-VISUAL AIDS: Chalkboard

INSTRUCTIONAL EQUIPMENT: Video monitor and 3/4" tape player

REFERENCES: Cable, Dwayne and Adams, John R., *Organizing for Project Management.* (Drexel Hill: Project Management Institute, 1982)

REQUIRED STUDENT PREPARATION:

a. Read article: *Matrix Management: Is it Right for Weapons Acquisition?*

b. Scan viewgraphs

DISCUSSION QUESTIONS:

1. Name the three basic types of organizational structures and discuss the characteristics, advantages, and disadvantages of each. [The advantages and disadvantages of each organizational structure are listed in the course text and videotape.]

2. Give some major guidelines for choosing an organizational form for a project.

3. In the matrix organizational structure, what tasks should the Project Manager have authority over? . . . the Functional Manager?

4. List some of the major functional areas found in a typical System Program Office (*SPO*)?

5. Why is the SPO so important in weapon system acquisitions? [Acronyms introduced in this lesson, and their descriptions]

MATRIX MANAGEMENT: Is It Right for Weapons Acquisition?

by
Dr. Michael B. Patterson
Babson College

Matrix management is a compromise between organizing by function and organizing by project. Currently, it is the subject of heated controversy within the weapons acquisition community where the mere mention of matrix management brings forth staunch praise or anguished condemnation.

Regardless of its merits, it is clear that matrixing means change, a departure from the established way of doing things and an opportunity to either improve or damage organizational performance. Recently, organizations such as the Aeronautical Systems Division at Wright-Patterson AFB, Ohio, and the Electronic Systems Division at Hanscom AFB, Massachusetts, have substantially increased the degree of matrixing within their units. Furthermore, this appears to be only the beginning of a trend that will extend to many other weapons acquisition organizations.

The purpose of this article is to briefly trace the evolution of matrix management and the two management forms that preceeded it as they were developed by industry and later adopted by weapons acquisition organizations. In addition, some cautions will be offered concerning the employment of matrixing in weapons acquisition organizations.

The Functional Structure

Until the early 1960s, the functional structure was a common organizational form for aerospace companies as well as for many other enterprises. An organization in which common skills or processes were grouped together offered several advantages for companies in that it promoted the efficient use of technical resources and helped maintain the quality of those resources. A functional structure also facilitated corporate memory in regard to technical solutions while offering advantages concerning morale and employee motivation.

How did a functional structure provide these advantages? Efficiency in functional organizations was gained by pooling similar skills into departments. While an individual project might not warrant the full services of a narrow specialization, a specialist assigned to a functional department could be kept fully employed supporting several projects. This enabled the company to hire highly specialized personnel and by allocating their efforts, keep them fully employed. The economy of scale realized by a functional organization allowed companies to retain these specialists and thus maintain or improve the overall caliber of their technical force.

Functional structures also offered the advantage of providing a corporate memory in each functional area. Rather than locking them away in a particular project office, the successes, failures and lessons of earlier projects were made accessible to all. For high technology companies, this ready access to experience was a valuable asset.

A further advantage of the functional structure lay in the areas of morale and motivation. Each functional department provided a home base for its personnel, one that could provide career development and allow individuals to progress within their technical area. This, in turn, promoted employee loyalty and provided an incentive to remain with the organization.

Functionally structured organizations also had a significant disadvantage. They were not responsive to project schedules. Although they increased technical capability, the fragmented efforts of individual technical departments often served as an impediment to timely project coordination. This was of particular concern to aerospace companies as they became increasingly involved with high priority, tightly scheduled space programs. The problem was further aggravated by employee's understandable tendency to place their loyalties with their functional department rather than commit themselves to the success of individual projects.

It was this lack of responsiveness to schedules that led aerospace corporations, and later their counterparts in government, to search for a better form of organization. Specifically, they wanted a structure that was responsive to both accelerated technology and the demands of high priority programs. The search led to the project structure.

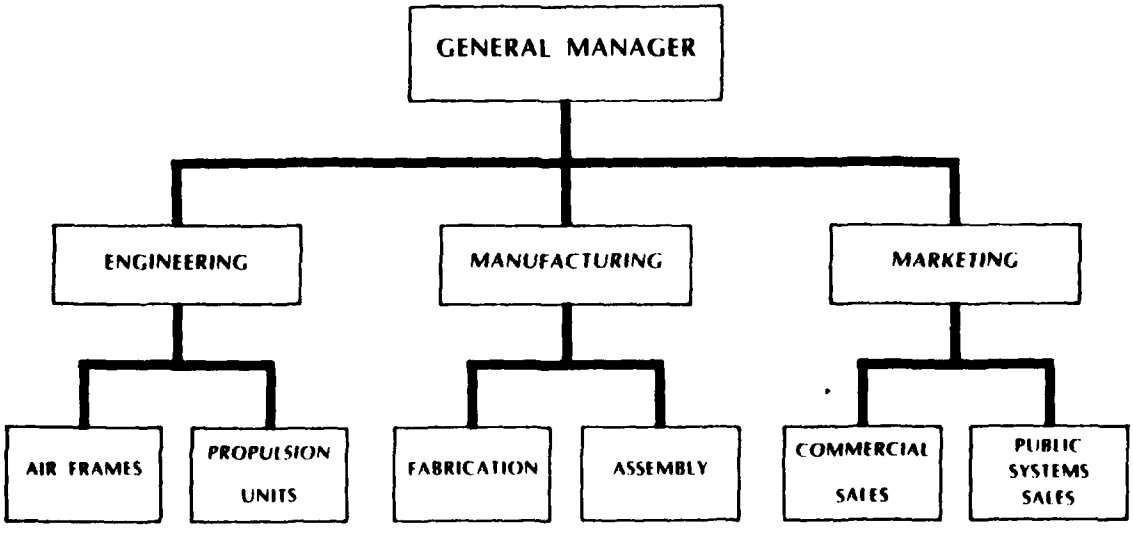
The Project Structure

In this organizational form the diverse specialities required for a project were assigned to a single office, under the direction of a project manager.[1] The result was an organization that was goal oriented and that could internally achieve program coordination. Thus, the project office was able to successfully respond to program schedules.

There were several strengths offered by project organizations. Not only was program integration facilitated by bringing the diverse functions under one organizational roof, but it was found to be a more adaptable form of organization with an improved facility for problem solving. These qualities were of particular importance in

Figure 1.

A Functional Organization (Industry)



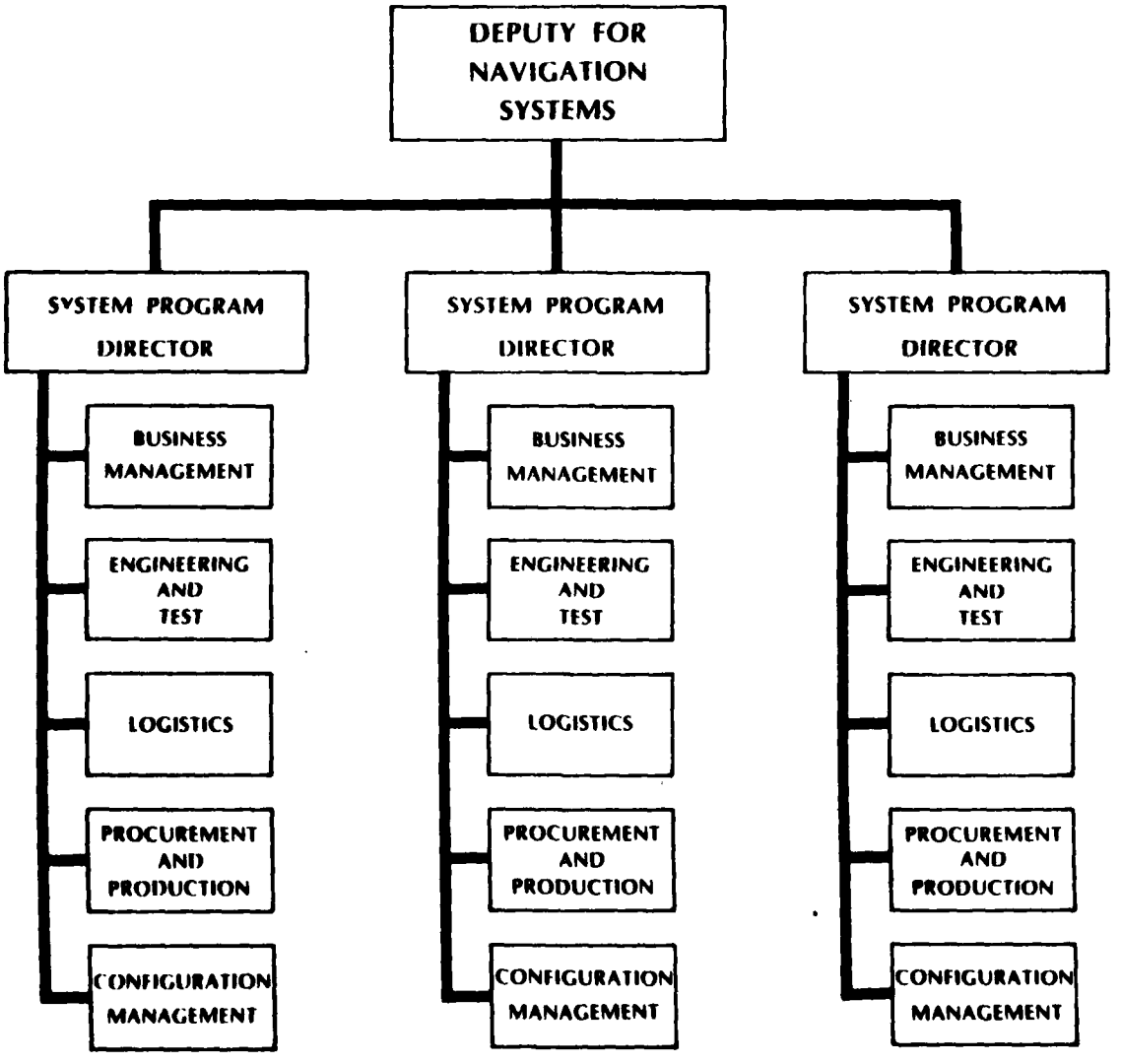
programs with rapidly changing, high priority requirements. Finally, it was found that as program direction and coordination improved under a single program manager, budget performance also tended to improve.[2]

However, the advantage of improved coordination and adherence to schedules and budgets was offset by several disadvantages. Project management was often found to be an expensive and inefficient use of resources. As one company manager recently complained, "We had six of everything. We had to operate at 92 percent capacity just to break even."[3]

Project structures also had a weakness in regard to employee morale. While functional organizations provided a degree of stability, project offices were intended to be of comparatively short duration, spanning only the life of the project. Consequently, there was a tendency for project members to become uneasy about their future. With no one to look to for career progress or long term development, morale, in some cases, suffered.

It was also found that project managers had an understandable tendency to retain their best and most experienced people. As a result, valuable experience

Figure 2.
A Project Organization (Air Force Systems Command)



remained locked in each project office and the lessons of the project were not shared.

Because of these shortcomings, aerospace and defense organizations again searched for a new organization structure. This search led to matrix management.

The Matrix Structure

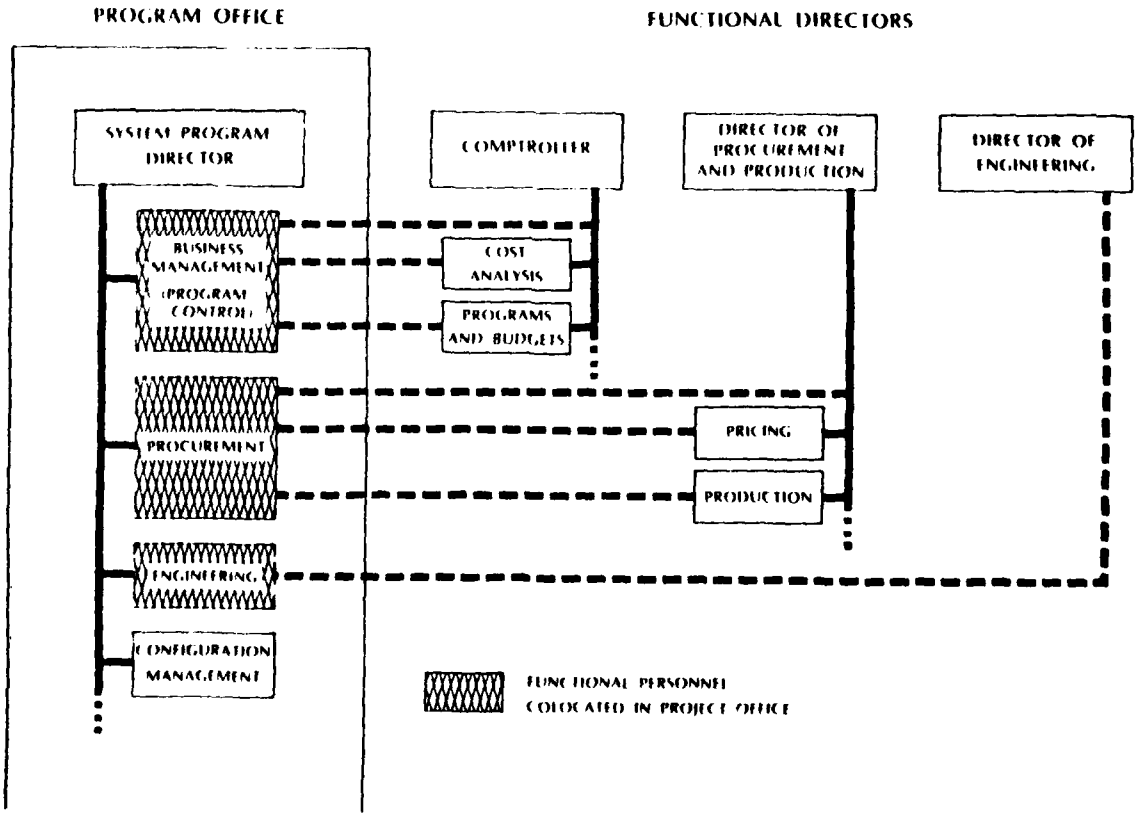
In a matrixed organization, an attempt was made to retain the benefits of both the functional and project organizations *while avoiding* their inherent disadvantages. For defense acquisition organizations this led to the matrixing of individual functions such as procurement or engineering. In other cases, such as that of a large, aggregate program office, all personnel functions were matrixed (see Fig. 4).

When matrixed, personnel are permanent members of their functional departments but are assigned on a full time or part time basis to project organizations. The result is a dual line of authority under which matrixed personnel must answer to both the individual program manager and the supervisor of the functional department. Inherent in the dual authority is a power balance between the project manager and the functional manager. This power balance is an important aspect of matrix management and as one author points out, "While equal power is an unachievable razor's edge, a reasonable balance can be obtained through enforced collaboration on budgets, dual information and reporting systems and dual authority relations."[4]

In general, it may be said that resource matrixing avoids the schedule and budget laxity of functional management, and in theory, avoids the maldistribution of resources sometimes found in project management. At the same time, it promotes the technical development inherent in functional management and the coordination and responsiveness inherent in project management.

As in the case with other organization forms, matrixing is not without pitfalls. The dual authority relationship can breed conflict, uncertain direction, and a

Figure 3.
A Simplified Matrix Organization for Systems Acquisition Management



pervading atmosphere of management by compromise. In addition to these universal pitfalls, there may be additional matrixing hazards that may be encountered as weapons acquisitions organizations matrix their resources.

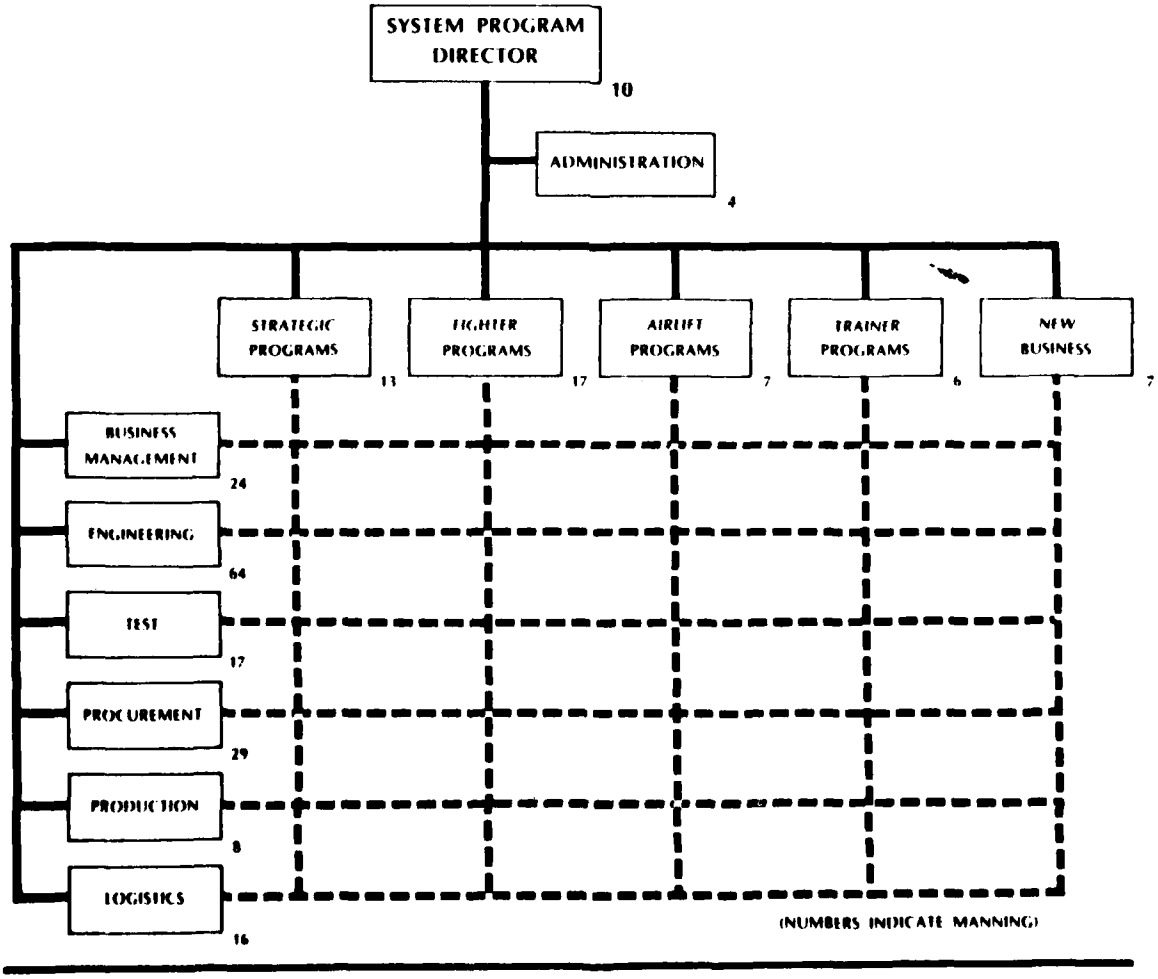
Hazards for Weapons Acquisition Organizations

Although matrixing is an attractive solution to a number of acquisition problems, matrixing may also be very difficult for these organizations to implement. This difficulty focuses on the areas of personnel resistance, increased internal conflict and the problem of establishing a power balance. Difficulties may also arise from the aspects of matrixing that simply go against the grain of military organization.

Matrixing destroys or alters many of the established methods of operating and leads to reduced authority for some decision makers. Thus, it may create or at least surface conflict. The result is that significant resistance may materialize from several sources within the organization. Although this alone should not rule out the change, it should be weighed against the advantages of changing to a matrixed structure.

A fundamental difficulty with matrixing is that it results in two or more lines of authority exercising decision making power over a project. Said one of General Electric's managers after undergoing matrixing, "The whole structure is intended to force conflict to the surface."[3] Surfacing conflict is desirable but only when an organization is adequately prepared to resolve it.

Figure 4.
A Large Project Office That Has Been Internally Matrixed (Simulator System Program Office, ASD (AFSC))



As previously mentioned, an organizational power balance is crucial to the success of matrix management. However, the whole concept of dual authority is contrary to the unity of command that military organizations have practiced for centuries. These long ingrained tenets are not easily overcome. Where the importance of this power balance is not recognized and resolved, attempts towards a successful matrix will ultimately fail.

In industry, some of the proponents of matrix management see it as a means of getting out from under the paper crush and speeding up decision making.[5] However, decision making will only be accelerated if more decision authority is delegated to decision makers at the program level. In weapons acquisition, decision making is a highly structured and jealously guarded prerogative. Significant decision making is maintained at least one level and often several levels above the program manager. Consequently, a lowered level for decision making will not necessarily result from the adoption of a matrixed system.

Ultimately, the decision to adopt matrix management should be based on a careful analysis of each acquisition function and the advantages versus disadvantages of placing that function in a matrixed organization. It may be found that while certain functions should be matrixed, others should be left where they are lest additional matrixing reduce organizational effectiveness. Decision makers should be alert to recognizing this point of diminishing returns and not simply be swept along in the tide of organizational change.

In summary, matrix management is a synthesis of its predecessors and as such provides many improvements for managing high priority, technically demanding and rapidly changing programs. Is it right for weapons systems acquisition? Only a careful and judicious analysis of each situation can provide that answer. Matrix management has much to offer, but for it to be successful it must be well conceived, skillfully employed and properly tailored to the problems at hand.



Dr. Michael B. Patterson

Dr. Patterson is a member of the Department of Management at Babson College, Babson Park, Mass. A Program Management Course 76-2 graduate, he has served in several program management positions in the Air Force including systems test, procurement and Deputy Systems Program Director. He has also served on the faculty of the Air War College.

CITED REFERENCES

1. Project offices may take many forms and have a wide range of sizes. For a detailed description of project organization see C. J. Middleton, "How to Set Up a Project Organization," *Harvard Business Review*, March-April 1967, pp. 19-28.

2. Jay R. Galbraith, "Matrix Organization Design," *Business Horizons*, February 1971, p. 30, and Middleton, "How to Set Up a Project Organization," p. 20.

3. "How to stop the buck short of the top," *Business Week*, January 16, 1978, p. 82.

4. Galbraith, "Matrix Organization Design," p. 36.

5. "How to stop the buck short of the top," *Business Week*, January 16, 1978, p. 82.

6. Ibid.

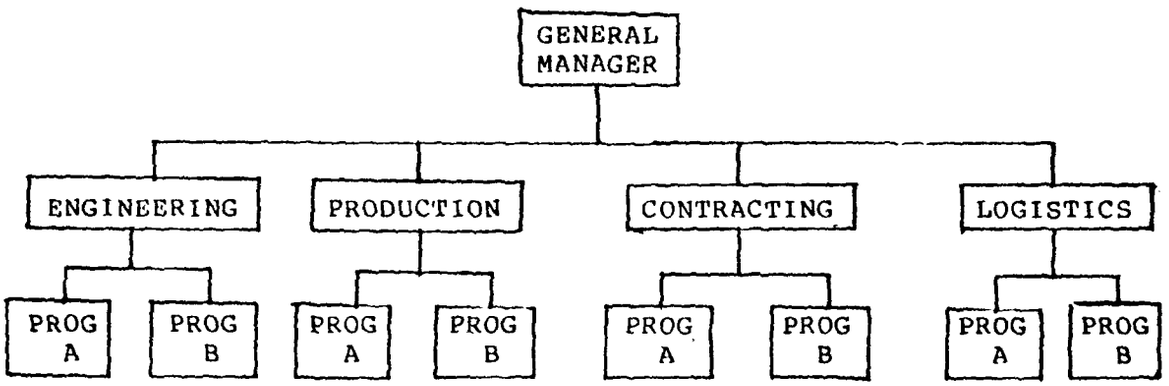
INTERNAL PROGRAM MANAGEMENT

ORGANIZATION

FIVE KEY ELEMENTS

0 SIZE	TWO OR MORE INDIVIDUALS,
0 INTERDEPENDENCE	WHOSE COMMON GOALS CAN BE MORE READILY ACHIEVED THROUGH INTERDEPENDENT (COOPERATIVE) ACTION,
0 INPUT	BY TAKING IN MATERIALS, ENERGY AND INFORMATION FROM THE ENVIRONMENT IN WHICH THEY EXIST,
0 PROCESS	WHO DEVELOP COORDINATIVE AND CONTROL RELATIONSHIPS TO CAPITALIZE ON THEIR INTERDEPENDENCE WHILE OPERATING ON THESE INPUTS,
0 OUTPUT	AND RETURN THE MODIFIED INPUTS TO THE ENVIRONMENT IN AN ATTEMPT TO ACCOMPLISH THE GOALS THAT INTERDEPENDENCE WAS MEANT TO MAKE POSSIBLE.

PURE FUNCTIONAL ORGANIZATION



FUNCTIONAL ORGANIZATION

ADVANTAGES

0 TECHNICAL EXCELLENCE

0 FLEXIBILITY IN USE OF SPECIALIST

0 CAREER DEVELOPMENT AND PROGRESSION

0 BUDGETARY CONTROL

0 DEFINED AUTHORITY AND RESPONSIBILITY RELATIONSHIPS

0 STRUCTURED COMMUNICATION CHANNELS

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FUNCTIONAL ORGANIZATION

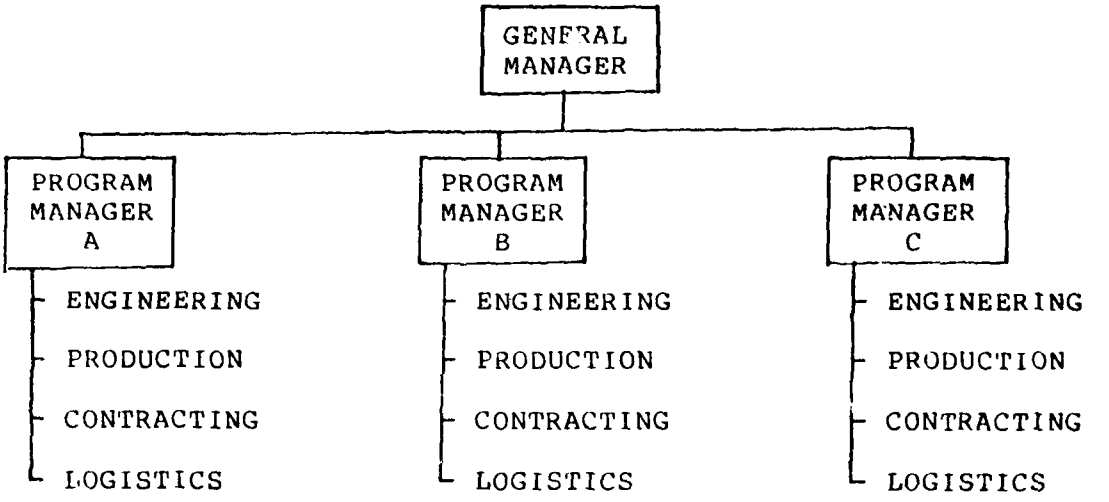
DISADVANTAGES

0 NOT RESPONSIVE TO PROGRAM OBJECTIVES

0 COORDINATION AMONG FUNCTIONS COMPLEX

0 DECISION MAKING BECOMES CENTRALIZED

PURE PROJECT ORGANIZATION



PROJECT ORGANIZATION

ADVANTAGES

0 RESPONSIVE TO PROGRAM OBJECTIVES

0 RAPID REACTION TIME

0 INTEGRATION FACILITATED

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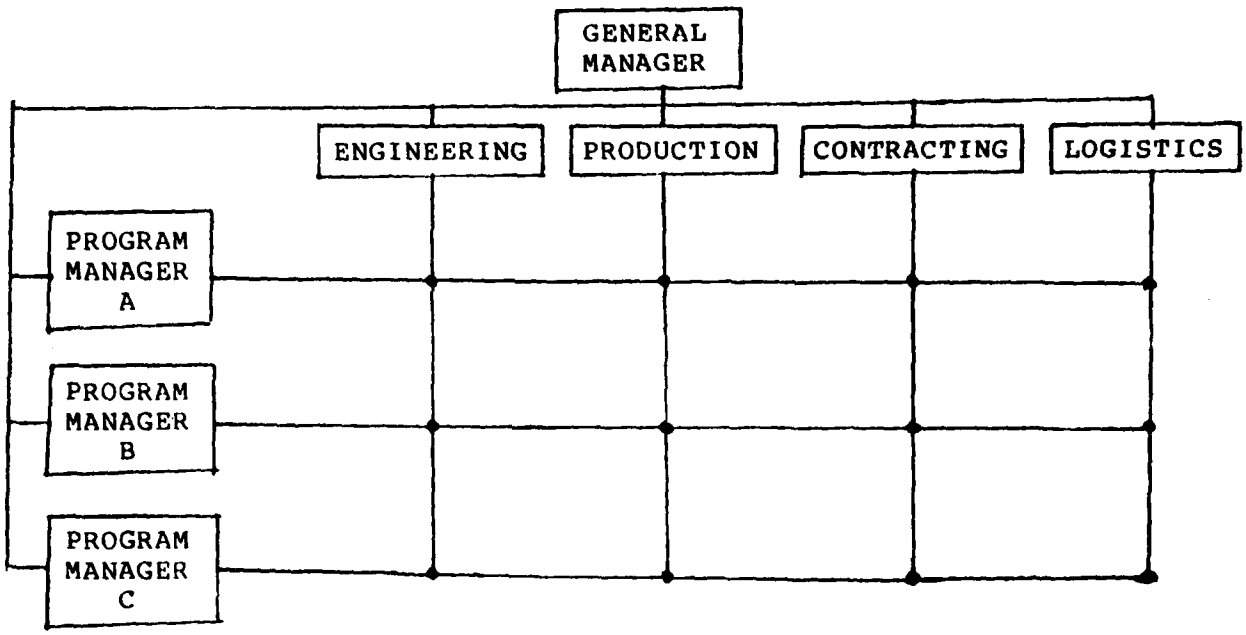
PROJECT ORGANIZATION

DISADVANTAGES

0 COST OF MAINTAINING ORGANIZATION

0 CAREER PROGRESSION

MATRIX ORGANIZATIONS



MATRIX ORGANIZATIONS

ADVANTAGES

- RESPONSIVE TO PROGRAM OBJECTIVES
- HIGHER MANPOWER UTILIZATION SPECIALISTS AVAILABLE TO ALL PROGRAMS
- FUNCTIONAL SPECIALISTS HAVE A "HOME" TO RETURN TO
- BETTER BALANCE AMONG COST, SCHEDULE AND PERFORMANCE IS OBTAINED

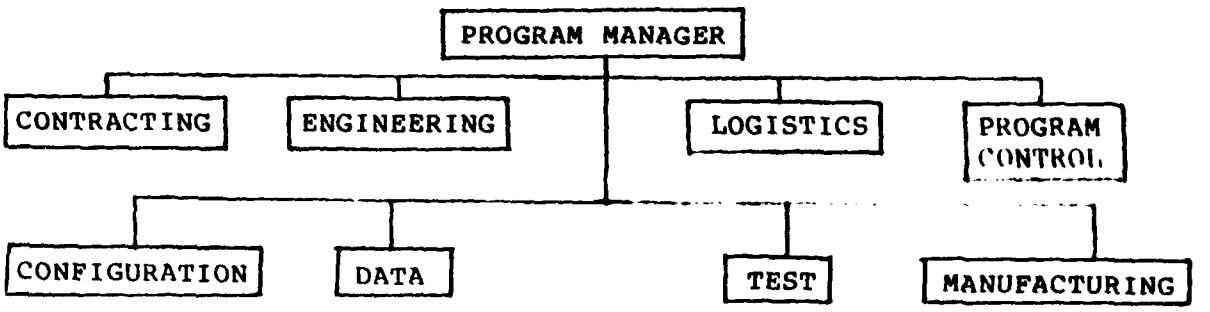
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MATRIX ORGANIZATIONS

DISADVANTAGES

- DUAL REPORTING RELATIONSHIPS
- RESOURCE ALLOCATION CONFLICTS
- SELF-PERPETUATING PROGRAMS
- BLURRED LINES OF AUTHORITY AND RESPONSIBILITY
- CAREER PROGRESSION OF FUNCTIONAL PERSONNEL
- COMPLEXITY OF MANAGEMENT

SYSTEM PROGRAM OFFICE



LESSON 3

LESSON TITLE: **External Program Management**

TIME: 1 hr

LESSON OBJECTIVE: The objective of this lesson is for each student to know the organizations external to the program office which participate in the acquisition of systems and the nature of their involvement.

SAMPLES OF BEHAVIOR: Each student will be able to:

a. State the responsibility of the Program Manager.

b. Describe how the program manager receives direction.

c. State the purpose and command level of each of the following reviews:

(1) Management Assessment Review (*MAR*)
(2) Command Assessment Review (*CAR*)
(3) Secretary of the Air Force Program Assessment Review (*SAFPAR*)
(4) Selected Acquisition Report (*SAR*).

d. Identify and give examples of:

(1) an Implementing Command
(2) a Supporting Command
(3) an Operating Command
(4) a Participating Command.

e. Describe the roles of the PEM, SYSTO, GAO, and AFPRO.

TOPIC INTRODUCTION:

With the concept of system acquisitions and typical organizational structures introduced, you also need to be aware of the many external participants that affect the successful outcome of your program. There are far too many participants in the acquisition process to talk about, in an introductory course. Therefore, we are going to address only a sample of participants; those that are usually very important to attaining program goals and objectives. To set the stage -- the program manager is the focal point in supporting goals and objectives. Clearly, the program manager is the one responsible for meeting technical, schedule, cost, and supportability goals (Reference AFR 800-2). The difficulty, in meeting these goals, is where the program manager earns her paycheck. The program manager is the one implementing DOD, USAF, and AFSC direction. She must decide daily acquisition issues, sometimes conflicting to each other, in fulfilling her mission and meeting her baseline (or agreements). Sometimes issues become too complex and cannot be resolved at the program manager level; therefore, they must be elevated to higher decision levels. The reporting process is very crucial to resolving these issues and in conveying confidence about your management capability. It is through preparation for, and presentation in, the reporting process that external participation in your program is heavy. Addressed in this lesson are examples of some of the different acquisition commands and external organizations that might significantly affect the success of your program. These can be excellent sources of information, and, significant members of your acquisition team; but, if you ignore them, they can hurt your success later with non-

support, or even worse, opposition to your program. So far, the focus has been on understanding some basic acquisition terminology and the types of organizations typically found in System Program Offices. Understanding the role of external participants involved with weapon system acquisitions is important for all program managers.

METHOD OF INSTRUCTION: Lecture/Discussion

INSTRUCTIONAL MATERIALS:

a. Article, *Program Management*, by Capt Adler, AFIT/LSY
b. *External Management* videotape
c. Lesson viewgraphs

AUDIO-VISUAL AIDS: Chalkboard

INSTRUCTIONAL EQUIPMENT: Video monitor and 3/4" tape player

REFERENCES:

a. DOD Directive 5000.1, *Major System Acquisition*
b. DOD Instruction 5000.2, *Defense Acquisition Program Procedures*
c. AFR 800-2, *Acquisition Program Management*
d. AFR 800-5, *Selected Acquisition Reports*
e. AFSCR 800-1, *Command Review of System Acquisition Programs and Test Resources*
f. AFSCR 550-10, *Focus on the User*
g. AFSCR 550-11, *Give the User Value*
h. AFSCR 550-20, *People*
i. AFSCR 550-22, *Program Management Baseline*
j. AFR 57-1, *Operational Requirements: Operational Needs, Requirements, and Concepts*
k. AFR 80-14, *Test and Evaluation*
l. AFR 800-4, *Transfer of Program Management*
m. AFR 800-25, *Acquisition Program Responsibility Baselining*

REQUIRED STUDENT PREPARATION:

a. Read article: *Program Management*
b. Scan lesson viewgraphs

DISCUSSION QUESTIONS:

1. Assume you have various commands represented in your SYS 100 seminar. Each command has a different role and mission in the outcome of your acquisition program. As Program Manager, your main concern is fielding a weapon system that is on cost, within schedule, performs to technical requirements, and is logistically supportable. With one person each taking the role of an implementing, supporting, participating, and operating command, discuss everyone's goals and objectives? Are they the same? Should they be the same? How would they differ? Describe some of the tradeoffs involved with each command in program management, especially in the early phases of the acquisition life cycle?

2. Differentiate between Air Training Command being directed to be a participating command for one program and an operating command for another program?

3. The Program Element Monitor (*PEM*), newly assigned to your program, wants know what are the key elements of your program because she has an upcoming congressional deadline. What information is indicative of the data your PEM needs to fairly represent your program?

4. What might be some of the key areas that would be reviewed at the Management Assessment Review (*MAR*), Command Assessment Review (*CAR*), Secretary of the Air Force Program Assessment Review (*SAFPAR*), and the Selected Acquisition Report (*SAR*)?

[Acronyms introduced in this lesson, and their descriptions]

Chapter 3

AFPRO	**Air Force Plant Representative**
CAR	**Command Assessment Reviews**
GAO	**General Accounting Office**
MAR	**Management Assessment Reviews**
PAD	**Program Action Directive**
PEM	**Program Element Monitor**
PEO	**Program Executive Officer**
SAFPAR	**Secretary of the Air Force Program Assessment Review**
SAR	**Selected Acquisition Reports**
SYSTO	**Systems Officer**

PROGRAM MANAGEMENT

PROGRAM MANAGER RESPONSIBILITY

During phases of the acquisition life cycle, the single Air Force manager leading the process of effectively attaining established cost, schedule, performance, and support objectives is the program manager. The program manager accomplishes this through the efficient use of government and contractor resources. He is the one who answers the *tough* questions involving trade-offs throughout the weapon system's development and procurement. The program manager is also the person responsible for delivering the weapon system according to established parameters in the program baseline (as outlined in AFR 800-25 . . . and AFR 800-6).

One of the most difficult responsibilities of the program manager is getting all supporting agencies to provide their support and resources in coordination with the program goals and objectives. The program manager's role involves fulfilling the goals and objectives, as established by government and contractor decision makers, and later described in System Program Office (*SPO*) documentation. This documentation might include describing such activities as Air Force Logistics Command's (*AFLC*) involvement early in the acquisition process and Air Training Command's (*ATC*) inputs for training requirements involving technical order generation and support equipment development. Other documentation might also include military construction programs, test and evaluation activities as managed by the Air Force Operational Test and Evaluation (*AFOTEC*) division, system engineering activities, configuration management plans, material availability with foreign sources, and/or virtually any possible factor/event affecting the program.

Clearly, the program manager's role is not limited to one specific phase, issue, plan, or activity but encompasses the whole realm of the system life cycle. Complicating this role is the fact that decisions need to be made in an environment where the system being developed usually does not exist. Also frustrating is the increasing level of outside influence making reaction time, program reporting, and decision making even more complex.

While all of this may seem impossible to *control*, this is the environment in which we, as government program managers, must manage and resolve daily issues. Therefore, program managers need to have an appreciation of the fundamental concepts involved in the acquisition process. The following discussion involves some of basic information necessary to understand the environment in which program managers must manage their systems.

The basis for the program manager's authority is DODD 5000.1 and DODI 5000.2 as implemented by AFR 800-2. DODD 5000.1 really is the document that lays the foundation governing the DOD acquisition process. It provides the philosophy on which program managers make decisions and explains why weapon systems move from one phase to another. DODI 5000.2, on-the-other-hand, supplements DODD 5000.1 providing the process to carry out the ground-rules established in DODD 5000.1. These ground-rules and policy apply across the DOD. The Air Force implements and applies the concepts through AFR 800-2, *Acquisition Program Management*, which is applicable and mandatory policy for all persons involved in acquisition programs and major modifications.

As program managers receive program direction, based on the guidelines in AFR 800-2, they must constantly weigh what needs to be done in the program versus what can be done. As direction flows down from higher headquarters, program managers need to be informed of what is required and expected of their weapon system. Two critical documents that provide program direction are the Program Management Directive (*PMD*) and AFSC Form 56. The PMD is normally issued from the HQ USAF level to the MAJCOM level. The PMD contains important information with regard to the program schedule and milestones, program participants, funding levels, the overall requirements that need to be met, and just about anything that is important to know. The PMD becomes an attachment to the Acquisition Decision Memorandum (*ADM*) which documents the Secretary of Defense's decision to approve/disapprove the program. The PMD is used during the entire acquisition cycle to state requirements, request studies, and initiate, approve, change, transition, modify, or terminate programs. The content of the PMD, including required review and approval actions, is tailored to the needs of each individual program. The AFSC Form 56 is supplemental tasking that flows down from HQ AFSC to the Product Divisions. Program Managers also are accountable for objectives identified in a baseline agreement with the Defense Acquisition Executive (*DAE*). Together with the DAE/Program Manager Baseline, AFSC Form 56, and Program Manager's charter, the PMD defines the Program Manager's specific responsibility, authority, and accountability for attaining program objectives.

REPORTING PROCESS

Performance reviews are required in the chain-of-command for resolution of major issues, milestone review, program changes and updates, and informational purposes. The type of review is dependent on the point of origin of the requesting office that generated the need for the review. Consequently, the type of review that program managers are typically exposed to is dependent on the level which the review is going to be presented. There are basically four reviews identified here, but these are not all-inclusive: the Management Assessment Review (*MAR*), Command Assessment Review (*CAR*), Secretary of the Air Force Program Assessment Review (*SAFPAR*), and Selected Acquisition Report (*SAR*). These reviews are for problem identification. The following is a simplified list of the purpose and command level of each review:

MAR -- Each program management area, such as system performance, schedule, test and evaluation, contracts, and so forth is rated either satisfactory, marginal, or unsatisfactory in a briefing that is reviewed at the product division level. Major problems are briefed at Headquarters Air Force Systems Command (HQ AFSC).

CAR -- The CAR essentially identifies and defines specific progress versus plan and potential/current problems by presenting key facts and information to decision makers. The CAR is reviewed at the HQ AFSC level.

SAFPAR -- The SAFPAR is an in-depth evaluation mechanism for selected programs. SAFPAR's are conducted on a quarterly or semi-annual basis. SAFPAR programs are selected by the Secretary of the Air Force.

SAR -- The SAR provides a summary of key cost, schedule and technical information on these types of DOD acquisition programs:

a. All programs designated as major systems under DODD 5000.1 and DODI 5000.2.

b. Any program Congress designates.

SARs are submitted annually as of December 31 and must reflect the President's Budget. Quarterly submissions are required when:

a. There has been a 5% or greater change in total program costs.

b. There has been a 3% or greater delay in the current estimate of any schedule milestone.

c. Corrections to variance calculations and adjustments have been approved by the Assistant Secretary of Defense (Comptroller).

By comparing current estimates with established baselines, the report provides consistent, reliable information on program status. This information relates to cost, test and evaluation data, future production deliveries, characteristics and contract data indicating contractor and award data, or any other area requiring justification. While most major programs submit the SAR, all program managers should understand its contents and procedures. Many staffers use the SAR format for discussing programs with the DOD and, expect program managers to be able to converse in SAR language.

ACQUISITION COMMANDS

The Air Force assigns specific responsibilities to commands involved in the acquisition of weapon systems. These responsibilities are explained and implemented in AFR 800-2. The following list describes these commands and their respective responsibilities:

Implementing Command -- The implementing command, usually HQ AFSC:

a. Performs tasks defined in the PMD.

b. Appoints a program manager and establishes a program office.

c. Establishes procedures for developing and approving the program acquisition strategy.

d. Delegates program management authority and responsibility to the program manager through a program manager's charter.

e. Through a program manager's charter, provides each program manager direction for each assigned system or discrete project or task. Sets forth in the charter:

(1) The relationship between the program manager and participating commands.

(2) Management and resource threshholds that define the program manager's latitude for management action and a commitment to provide all further direction by a PMD and supplemental direction.

(3) Other items deemed significant by the Program Executive Officer (*PEO*).

Participating Command -- The participating commands:

a. Provide support and take part in carrying out the assigned tasks of the PMD and other program documentation.

b. Accomplish the fiscal planning and coordinate plans with other participating commands to identify the budgeting and funding to support assigned program tasks.

c. Designate staff focal points that are commensurate with command involvement.

Supporting Command -- The supporting command, usually Headquarters Air Force Logistics Command (HQ AFLC):

a. Assists the program manager in planning and conducting the integrated logistic support program.

b. With the implementing and operating commands, develops, analyzes, and reviews support requirements, supportability considerations, affordability, and logistics support alternatives and requirements.

c. Plans for the transfer of program management responsibility (AFR 800-4).

d. For the operating command, develops the Depot Support Requirements Document (*DSRD*). The DSRD will be an adjunct to the System Operational Requirements Document (*SORD*) (AFR 57-1).

Responsibilities of Air Training Command (HQ ATC) -- As a participating command, HQ ATC helps the implementing, operating, and supporting commands:

a. Define training concepts.

b. Identify training requirements.

c. Assess costs and risks associated with training program alternatives.

d. Determine milestone schedules for developing planned training capabilities.

e. Per AFR 80-14, take part in test and evaluation.

Responsibilities of Headquarters Air Force Operational Test and Evaluation Center (HQ AFOTEC) -- As a participating command, HQ AFOTEC:

a. Per AFR 80-14, manages the operational test and evaluation (*OT&E*) program.

b. Recommends to the Defense Acquisition Executive, Air Force Acquisition Executive, and, PEO the extent of HQ AFOTEC, supporting, and operating command involvement in OT&E programs.

c. Identifies the training requirements for test team personnel.

Operating Command -- As a participating command, the operating command:

a. Develops the SORD for the preferred alternative candidate solution recommended for a Milestone I review. A SORD is mandatory for all major and Air Force Designated Acquisition Programs (*AFDAP*).

b. Refines and expands the SORD for the candidate solutions, which were validated during the Demonstration/Validation phase and recommended for a Milestone II (Full Scale Development) decision.

c. Develops and submits operational and maintenance concepts, plans, and requirements before each program milestone decision is considered.

d. Identifies training requirements to HQ ATC.

The role of the Operating Command, or user of the weapon system, is very important in the acquisition process. The AFSC Commander has recently reinforced the importance of the using commands in the AFSC 550 series of regulations. The basic mission of AFSC is to support the using commands. To accomplish this, we must be close to our customers. This concept must permeate our management of programs, our testing of

systems, and our exploration of technologies.

ACQUISITION PARTICIPANTS

Finally, be familiar with key individuals and organizations that affect the acquisition of weapon systems. The following are just a few that could greatly influence your program:

Program Element Monitor (PEM) -- A very important acquisition member of your SPO is the PEM, who is a member of Air Staff. The PEM is the expert everyone turns to for any and all information concerning his program(s). The PEM presides over a program from the pain of birth, through the joy of growth and success, and possibly the agony of death. The PEM provides the *corporate memory*, is an indispensable link between the using command(s) and the Air Staff, and is the program spokesman for anyone, anytime. In other words, the PEM is the primary advocate for your program. To provide care and feeling for his programs, the PEM prepares and updates budget requests, and guidance documents, as required. The PEM also reviews Congressional testimony, answers questions for the record, and prepares the PMD. The bottom line is that the PEM must stay constantly alert to keep abreast of what is a very fluid situation.

System Officer (SYSTO) -- The SYSTO is AFSC's equivalent to the PEM. The SYSTO performs some of the same functions as the PEM but at a different level -- HQ AFSC. The SYSTO is the officer who is the focal point for staff actions associated with a particular program (per AFSCR 800-1). The SYSTO updates periodic briefings like the SAFPAR at the HQ AFSC level.

General Accounting Office (GAO) -- The GAO is an agency in the legislative branch of the government and is considered the audit or oversight agency of the Congress. It is headed by the Comptroller General of the United States. The GAO will assist the Congress by:

a. Providing information, services, facilities, and personnel to the Congressional Budget Office.

b. Assisting congressional committees in developing statements of legislative objectives, goals, and methods for assessing and reporting program performance.

c. Assisting committees in analyzing and assessing federal agency program reviews and evaluation studies.

Air Force Plant Representative Officer (AFPRO) -- The AFPRO is the Air Force representative physically located at the contractor's facility. Consequently, the AFPRO is a rich source of information concerning many aspects of your program. They should know the contractor's business environment, since they are right there. AFPROs can provide current wage rates, contractor performance, learning curve rates, past history on similar programs, program tasks and their status with the contractor, and just about anything else related to the contractor's performance.

Other participants -- Other participants include those federal agencies who might have a vested interest in your program. These participants include organizations that have similar goals and objectives as your program. For instance, if your program involves joint service usage with the Army, Navy, and/or Marine Corps, they would be

major actors in the acquisition of your weapon system. If your program is to be deployed in space, the National Aerospace and Space Administration might be involved in your program. The Federal Aviation Administration might have inputs with regard to the safety of certain weapon systems being deployed in the continental United States. As you can guess, the list does not stop here. As program manager, you may have a myriad of organizations throughout the DOD to deal with during an acquisition life cycle.

PROGRAM MANAGERS AUTHORITY

SOURCE: AFR 800-2

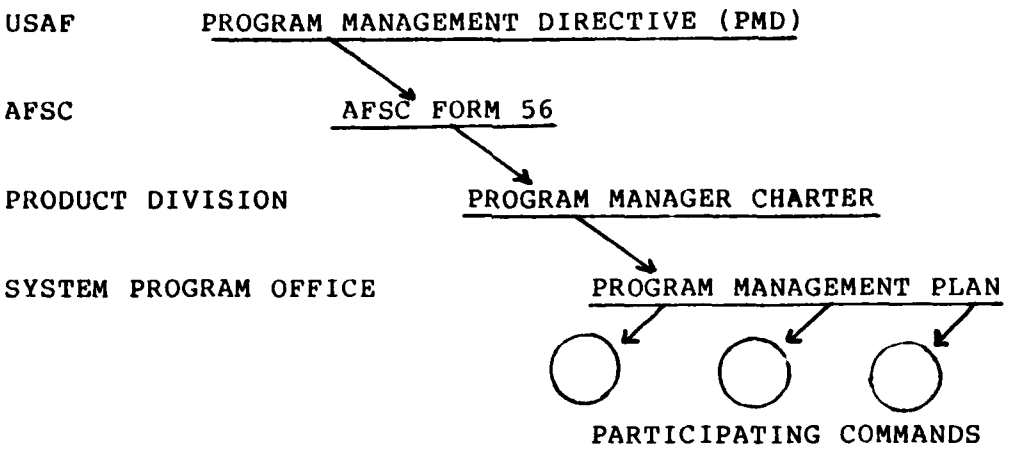
DODD 5000.1

DODI 5000.2

DEFINITION: SINGLE AF MANAGER RESPONSIBLE FOR ACQUIRING AND FIELDING A SYSTEM THAT MEETS THE APPROVED MISSION NEED AND ACHIEVES THE ESTABLISHED.

- 0 COST GOALS
- 0 SCHEDULED GOALS
- 0 PERFORMANCE GOALS
- 0 LOGISTICS SUPPORT GOALS

FLOW OF DIRECTION



***

PRIMARY CONCERNS OF PROGRAM MANAGER

0 PLAN TO IMPLEMENT DIRECTED PROGRAM

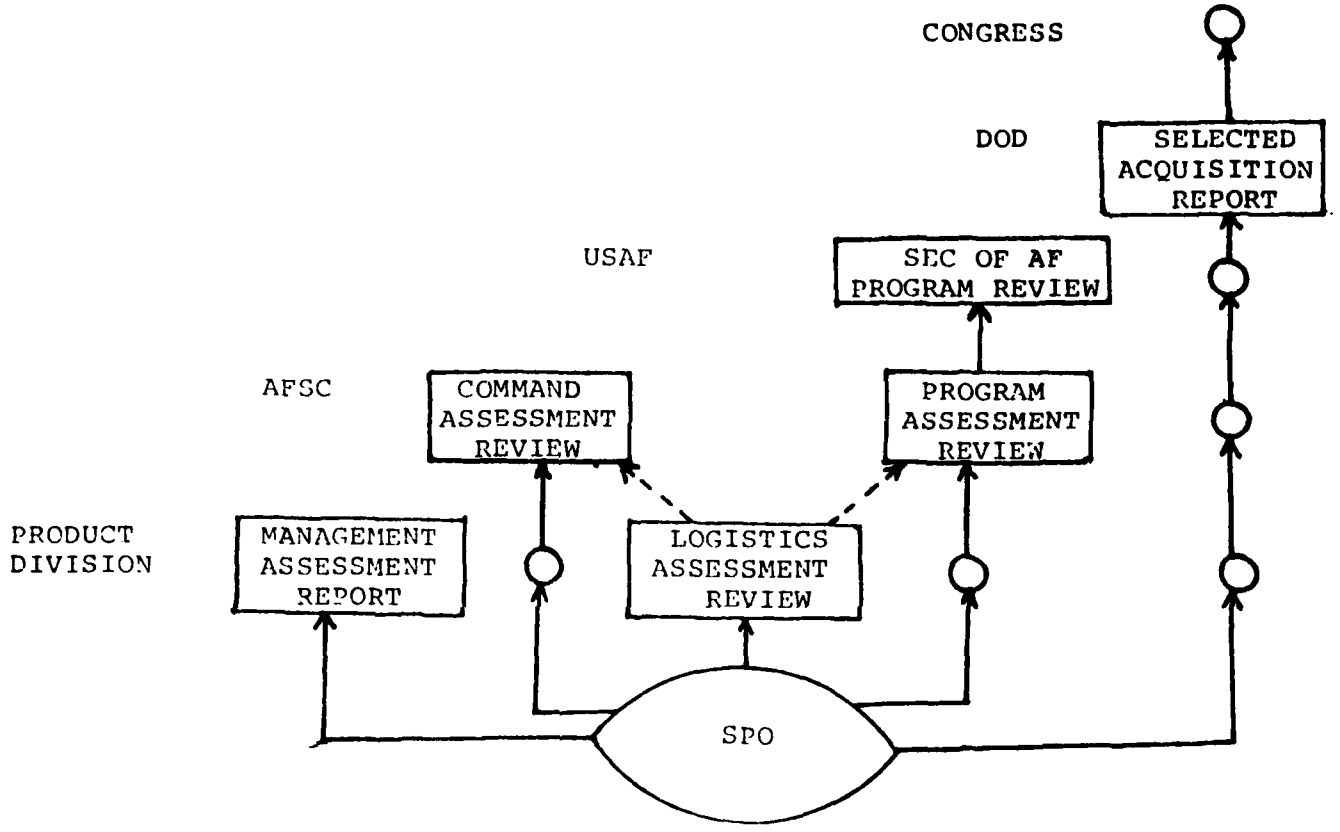
0 IDENTIFY AND OBTAIN RESOURCES

- * PEOPLE
- * MONEY

0 DETERMINE STATUS

0 ADJUST PLANNING

FLOW OF REPORTING



IMPLEMENTING COMMAND

THE COMMAND CHARGED WITH PRIMARY RESPONSIBILITY FOR DEVELOPING AND ACQUIRING THE SYSTEM OR EQUIPMENT

***

SUPPORTING COMMAND

COMMAND CHARGED WITH RESPONSIBILITY FOR PROVIDING LOGISTICS SUPPORT AND DESIGNATED TO ASSUME PROGRAM MANAGEMENT RESPONSIBILITY FROM THE IMPLEMENTING COMMAND.

***

OPERATING COMMAND

THE COMMAND OR AGENCY PRIMARILY RESPONSIBLE FOR THE OPERATIONAL EMPLOYMENT OF A SYSTEM, SUBSYSTEM OR ITEM OF EQUIPMENT

***

PARTICIPATING COMMAND

A COMMAND OR AGENCY DESIGNATED BY HQ USAF PROGRAM MANAGEMENT DIRECTIVE (PMD) TO SUPPORT AND ADVISE THE IMPLEMENTING COMMAND DURING A DEVELOPMENT OR ACQUISITION PROGRAM

***

HQ AFSC PLAYERS

- 0 PROGRAM ELEMENT MONITOR (PEM)
- 0 SYSTEMS OFFICER (SYSTO)
- 0 PROGRAM MANAGEMENT ASSISTANCE GROUP

LESSON 4

LESSON TITLE: **Acquisition Process**

TIME: **2.5 hrs**

LESSON OBJECTIVE: The objective of this lesson is for each student to know the management concepts and decision process which governs the acquisition of Air Force systems and equipment.

SAMPLES OF BEHAVIOR: Each student will be able to:

a. State the philosophy of the Air Force in the following areas:
   (1) The single point manager
   (2) Incremental resource allocation
   (3) Competition.

b. Describe the process of a DOD major program initiation.

c. List the purpose of and activities that occur during the following life cycle phases:
   (1) Concept Exploration/Definition
   (2) Concept Demonstration and Validation
   (3) Full-Scale Development
   (4) Production and Deployment
   (5) Operational Support.

d. Identify the following milestones, the level of decisions, and their relationship to the phases of the acquisition life cycle:
   (1) Mission Need Determination (Milestone 0)
   (2) Milestone I
   (3) Milestone II
   (4) Milestone III
   (5) Milestone IV
   (6) Milestone V.

e. State how the decision process differs between a DOD Major program and a Non-Major program.

f. List the objectives and goals of the Reliability and Maintainability (*R & M 2000*) program.

TOPIC INTRODUCTION:

With the information you have assimilated so far about the acquisition of weapon systems, nothing is more important than understanding the life-cycle of the acquisition process. You, as the program manager, need to understand where your program fits into the acquisition life cycle. For example, your program may be in the Concept Exploration/Definition phase, where ideas are being generated on how to meet the mission need, or your program might be starting out in the Production phase, where there is no requirement for Concept Exploration/Definition, Concept Demonstration and Validation or Full-Scale Development. (This was the case of the Air National Guard's Air Defense Fighter, where the PMD stated you will buy a fighter where no development is

required.) The Air Force philosophy on program management stems from the concept of one person being responsible, at all times, for the program in satisfying user and acquisition requirements, budget constraints (more on budget in lesson 5), and iterative milestones and reviews. These milestones and reviews, in the acquisition life-cycle, are nothing more than decision points, taking a program in an orderly progression from an identification of system need to final operational deployment. In doing this, each program manager must *tailor* their approach to maximize use of the resources available. One of the program manager's goals in the acquisition process is to ensure that weapon systems are reliable and maintainable, once deployed; consequently, that reliability and maintainability planning is done early enough in the program's development.

METHOD OF INSTRUCTION: Lecture/Discussion

INSTRUCTIONAL MATERIALS:

a. Article, *The Acquisition of Major Systems*, by Mr McCarty, AFIT/LSY (Same as lesson 1)
b. Article, *Air Force Reliability and Maintainability Program*, USAF Fact Sheet 85-27
c. *Acquisition Process* videotapes
d. Lesson viewgraphs

AUDIO-VISUAL AIDS: Chalkboard

INSTRUCTIONAL EQUIPMENT: Video monitor and 3/4" tape player

REFERENCES:

a. DOD Directive 5000.1, *Major System Acquisition*
b. AFR 800-2, *Acquisition Program Management*
c. AFR 800-19, *System/Equipment Turnover*
d. AFR 800-4, *Transfer of Program Management Responsibility*
e. AFSCP 800-3, *A Guide for Program Management*

REQUIRED STUDENT PREPARATION:

a. Read article: *The Acquisition of Major Systems*
b. Read article: *Air Force Reliability and Maintainability Program*
c. Scan lesson viewgraphs

DISCUSSION QUESTIONS:

1. Briefly discuss the key functions to be performed in each of the five phases of the acquisition process.

2. Describe the acquisition problems and solutions of the 1970's with the problems and solutions of the 1980s.

3. Briefly discuss the main thrust of the Packard Commission recommendations that will impact the acquisition process in the 1980s and 1990s.

4. Briefly discuss how Reliability and Maintainability goals and objectives relate to the acquisition process.

[Acronyms introduced in this lesson, and their descriptions]

See Lesson # 1 Acronyms, since the reading for Lesson # 4 is the same.

Fact Sheet

United States Air Force
Secretary of the Air Force, Office of Public Affairs, Washington, D.C. 20330

85-27

Air Force Reliability and Maintainability Program

The Air Force Reliability and Maintainability (R&M 2000) Program was developed by direction of the secretary of the Air Force and chief of staff of the Air Force to institutionalize the Air Force's commitment to improving reliability and maintainability of weapon systems. Reliability and maintainability must be coequal with cost, schedule and performance factors as the Air Force brings new systems into the inventory and modifies its existing systems. The R&M 2000 program, which is managed by the special assistant for reliability and maintainability assigned to the Directorates of Logistics and Engineering, and Research, Development and Acquisition at Headquarters U.S. Air Force.

The Air Force requires improved reliability and maintainability of both new and fielded weapon systems. To achieve this, the Air Force is stepping up its search for basic system changes that will ensure the most reliable, maintainable systems possible for the dollar invested. Reliability and maintainability are means to an end, and that end is combat capability. Reliable systems reduce the ownership costs of systems, reduce the system's dependence on spare parts, require fewer combat support people and result in more missions per deployed system. If systems are more maintainable, fewer people with highly specialized diagnostic skills are needed and maintenance times to repair systems are reduced.

Equally important, reliability and maintainability improve the mobility of the forces because of the reduced need to deploy maintenance people and support equipment. Improved reliability and maintainability in current and future systems will provide the Air Force significant increases in combat capability.

Reliability and Maintainability Explained

The terms reliability and maintainability are related but separate. The distinction should be understood.

Reliability is officially defined as the probability that an item will perform its intended function for a specified interval under stated conditions. In the simplest sense, reliability means how long an item (such as a machine) will perform its intended function without a breakdown. For example, if your car runs well and never breaks down, it is highly reliable. A reliable car, like a reliable aircraft, does not have to go to the repair shop very often.

When it does break down, how difficult is it to troubleshoot and repair? That introduces the concept of maintainability. Maintainability is defined, officially, as the

ability of an item to be retained in, or restored to, specified condition when maintenance is performed by people having specified skill levels, using prescribed procedures and resources. Early mass-produced cars were simple and easy to repair -- very maintainable -- but not very reliable; they broke down too often. Modern aircraft, like late model cars, are much more complex. When they break down, they are more difficult to repair and it takes highly skilled mechanics to repair them.

The challenge of the Air Force Reliability and Maintainability (R&M 2000) Program is to ensure equipment and systems designs promote reliability -- operate long and well between breakdowns; and is maintainable -- repaired easily and efficiently by people trained to reasonable skill levels using practical tools.

Objectives

The objectives of the R&M 2000 program are to:

Provide clear direction aimed at increasing reliability and maintainability of Air Force systems to increase weapon system combat effectiveness.

- Focus organizational attention and expand training to build the reliability and maintainability technical expertise, advocacy, authority and accountability throughout the Air Force.
- Improve reliability and maintainability planning to consolidate efforts, tie reliability and maintainability to operational goals, and coordinate major command efforts to accelerate improvements in weapon system reliability and maintainability.
- Establish internal administrative systems in order to ensure effective accountability and feedback to measure progress in the reliability and maintainability improvement program.
- Provide positive communications and motivation to sustain commitment to and support for reliability and maintainability goals.
- Obtain and sustain industry commitment to ensure that contractors have the motivation and capability to support reliability and maintainability requirements.

Goals

The Air Force has set five goals to achieve the objectives of the R&M 2000 plan. The achievement of these goals requires institutional commitment to reliability and maintainability in the Air Force weapon systems. These goals are:

- Increase warfighting capability.
- Increase survivability of the combat support structure.
- Decrease mobility requirements per deploying unit.
- Decrease manpower requirements per unit of output.
- Decrease costs.

Increase Warfighting Capability

The U.S. Air Force will measure increased warfighting capability for each of its many different kinds of weapon systems. For aircraft warfighting capability, for example, improvements are expected in the number of consecutive missions a system is capable of flying in combat without requiring maintenance other than refueling and reloading ordinance. The future advanced tactical fighter of the 1990s will be designed to operate at a sustained sortie rate at least twice that of the F-15 Eagle.

Increase Survivability of the Combat Support Structure

Many current Air Force systems are dependent on large combat support facilities which are vulnerable to attack and destruction under combat conditions. The key to increased survivability is to reduce dependence on vulnerable fixed operating bases. One way to do this is to make use of technological advances that will reduce dependence on complex maintenance facilities such as the avionics intermediate shop needed to support such systems as the F-15 and F-16 Fighting Falcon. The design of more maintainable systems is absolutely essential to attain the necessary improvements in the Air Force combat capability for the 1990s. Reducing the need for sophisticated and

complex test equipment like the avionics intermediate shop means that fewer combat support people and highly trained maintenance specialists would be placed "in harms way" during a conflict.

Decrease Mobility Requirements Per Deploying Unit

Through reliability and maintainability improvements, such as Air Force fighter aircraft with built-in test and on-board fault detection and isolation system, fewer maintenance people and less support equipment would be needed in a combat zone. Presently more than five C-141B Starlifters are needed to airlift an avionics intermediate shop for a deploying squadron of F-15s. It now takes about 18 C-141B aircraft loads (equivalent) to deploy an F-15 squadron.

By reducing dependence on an avionics intermediate shop through improvements in the avionics system, the Air Force could deploy four squadrons of F-15s with the same airlift required to deploy three squadrons today.

Decrease Manpower Requirements Per Unit of Output

Gains in reliability and maintainability translate directly into increased productivity for the highly trained, highly skilled technicians needed to maintain today's aerospace systems. Air Force people are a constrained resource which must be considered during the earliest design stages of weapon systems.

Maintenance people require training, shelters, chemical, biological and radiological protection, and other combat support activities to provide for their well-being. The combat support activities require personnel support themselves.

Reliability and maintainability improvements will provide the Air Force with the opportunity to reduce dependence on combat support people in future systems, and the potential to reallocate already constrained people resources into priority Air Force activities.

Decrease Costs

The decrease in costs through improved reliability and maintainability would come from savings in areas such as acquisition costs, operating and support costs, manpower, training and spare parts costs. These reliability and maintainability savings can be reinvested in other Air Force modernization efforts.

For example, the Air Force manages approximately 835,000 different types of spare parts. The parts inventory is worth more than $38 billion. In fiscal 1985, the budget contained more than $6 billion for spares. Management of spare parts involves a highly complex system that employs hundreds of thousands of people. Consequently the higher the reliability of Air Force systems, the smaller the requirement for spare parts and the greater potential for savings.

Accomplishments

Recently the Air Force decided not to proceed with a $250 million dollar program for radar warning receivers. While a new radar warning receiver is badly needed to replace the current one, the proposed system did not offer significant reliability and maintainability increases over the one already fielded. The Air Force stopped the program and is now recompeting the procurement of a new radar warning receiver.

Low-Altitude Navigation and Targeting Infrared System for Night (LANTIRN) is one of the Air Force's highest priority programs designed to take the night sanctuary from the enemy. The LANTIRN navigation pod procurement program has been restructured to ensure the Air Force obtains a system which meets not only performance requirements, but also stringent reliability and maintainability growth goals. The goals must be met prior to approval of each successive production lot purchase. Furthermore the reliability and maintainability goals for LANTIRN are provided for under a firm fixed price contract. The Air Force will go no further with a new production lot until the reliability goals are achieved.

A key program under the R&M 2000 umbrella, the Blue Two Visit program contributes to achieving the Air Force R&M 2000 goals. The Blue Two visits take lead design engineers from defense contractors to the various locations where their equipment or similar systems are in use on Air Force flight lines.

The term "Blue Two" is the nickname of the Air Force men and women who must maintain the modern weapon systems in the Air Force inventory. The visits are intended to show the design engineers what the real world of aircraft maintenance is like.

This is not a vacation for those designers. They go out to the flight line and the maintenance shops where the life line of Air Force weapon systems is sustained. The engineers see operations and maintenance of systems first-hand -- to include participating in early morning and late night mission launches with the maintenance force . . . donning chemical, biological and radiological attire -- to work on the systems they may have had a hand in designing.

The Blue Two visits permit the engineers to observe the current job routines of Air Force maintenance people . . . to discuss with those military and civilian maintenance people what they find frustrating or rewarding with existing equipment . . . to discover problems encountered with overspecialization in tools, or the inability to use tools designed in isolation from the real work environment . . . to witness where the dependencies or interdependencies occur among the maintenance and supply activities found in Air Force sortie generating organizations. The Blue Two visits and other R&M 2000 initiatives are accelerating improvements to Air Force systems.

Significant improvements to Air Force weapon systems have been made in recent years. R&M 2000 will increase the pace of those improvements. Current systems are more reliable and maintainable than the systems they replaced. For example, the F-15 requires only 85 percent of the maintenance manhours per flying hour than the older F-4 Phantom aircraft. The F-16 requires only one-half the maintenance manhours per flying hour as the F-4.

For cargo aircraft, the Air Force expects the C-17 to require less than one-half the maintenance manhours per flying hour of the C-5A Galaxy.

The maintenance manhours per flying hour are significant factors since, of the more than 485,000 enlisted people in the Air Force today, one in every three is involved in maintaining aircraft. Through the R&M 2000 program and such initiatives as the Blue Two Visit program, the Air Force expects to further improve the maintenance requirements of both new and current weapon systems.

Summary

The Air Force R&M 2000 goals provide the key leverage points for achieving increased combat capability; increased survivability of the combat support structure; decreased mobility requirements per deploying unit; decreased manpower requirements per unit of output; and decreased costs. Revising the way the Air Force views reliability and maintainability will not be enough. R&M 2000 is a cultural change within the Air Force and defense industry. Reliability and maintainability are now coequal with the cost, schedule and performance factors associated with the acquisition of new systems and modifications to existing systems.

Reliable and maintainable systems are not an end -- they are a means to an end -- and that end is increased combat capability. The Air Force is making reliability and maintainability in new systems more visible throughout the weapon system acquisition process. The Air Force is demanding from itself, and the contractors who support it, accelerated improvements in the reliability and maintainability of weapon systems.

The payoff from these and other improvements in reliability and maintainability will be enhanced combat capability and an improved deterrent posture for America's "Arsenal of Democracy."

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THE ACQUISITION PROCESS
LESSON OVERVIEW

- ACQUISITION GUIDANCE
  - -- Single Point Manager
  - -- Incremental Resource Allocation
  - -- Competition
  - -- Categories of Programs
- ACQUISITION PHASES
  - -- Purpose and Activities
  - -- Milestone Reviews
  - -- Program Documentation

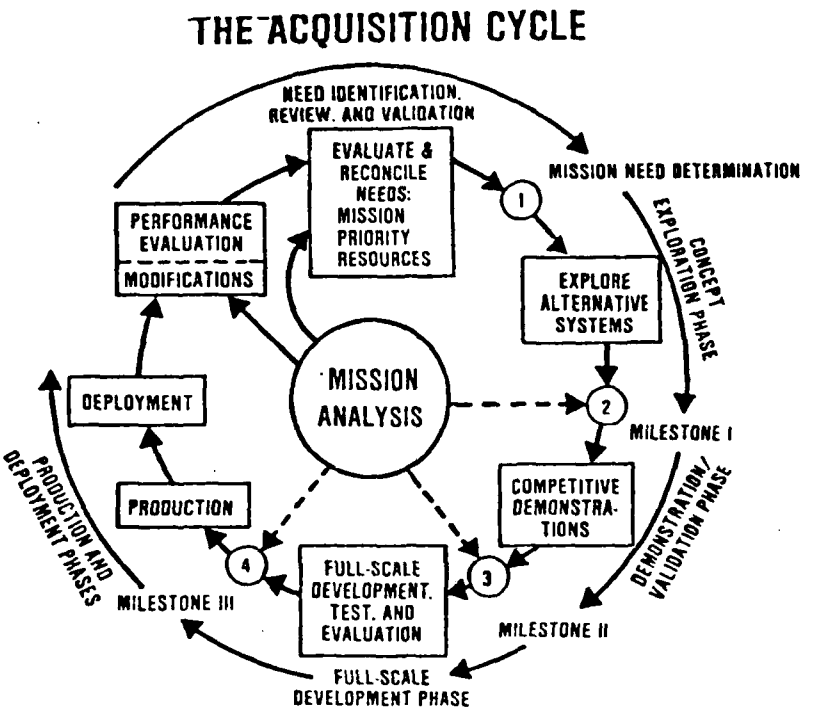
ACQUISITION GUIDANCE

OFFICE OF MANAGEMENT AND BUDGET
CIRCULAR A-109

- Applies to all Federal Executive Agencies
- Operational Need in terms of Mission
- An extensive use of competition

FLOW DOWN REGULATIONS

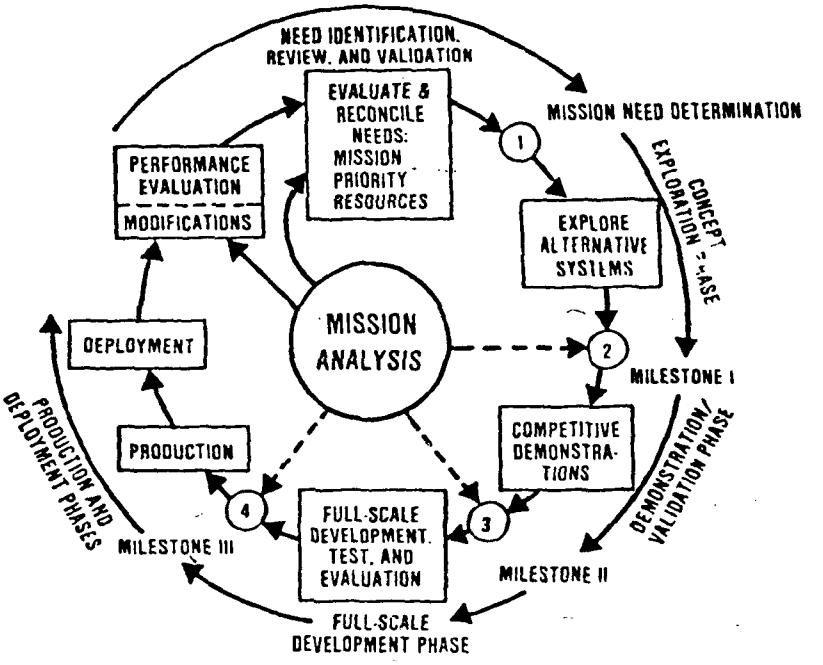
- DODD 5000.1/DODI 5000.2
- AFR 57-1
- AFR 800-2



ACQ INITIATION PROCESS

* MISSION AREA ANALYSIS
* STATEMENT OF OPERATIONAL NEED
* BUDGET COMPETITION
* PROGRAM MANAGEMENT DIRECTIVE
* FORM 56/PAD

THE ACQUISITION CYCLE



PHASE I
CONCEPT EXPLORATION

- EXPLORE Alternatives
- ESTIMATE Cost, Schedule, Performance and Logistics Parameters for each Alternative
- System Concept Paper

DOD MAJOR PROGRAM

* Cost: $200M FY 80 R&D
  $1B FY 80 PROD
* Joint Service Acquisition
* International Program
* Congressional Interest
* Sec Def Interest

MILESTONE I

* SYSTEM CONCEPT PAPER
* ISSUES

  Threat
  Weapon Concept
  Risk
  Schedule
  Readiness
  Affordability
  Acquisition Strategy

* NOT-TO-EXCEED THRESHOLDS

  Concept Validation
  Early Full Scale Development

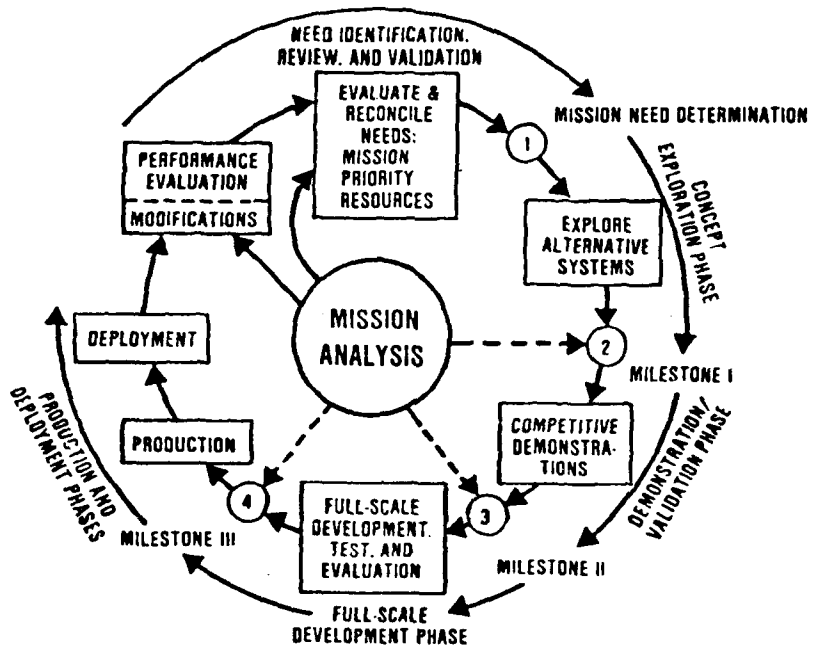
DEFENSE ACQUISITION BOARD (DAB)

* OSD level "corporate vice presidents"
* Reviews major programs
* In decision-making process
* Recommends to SECDEF - approval to enter next phase
* Does not provide funds or vote

SECRETARY OF DEFENSE DECISION MEMORANDUM (SDDM)

* DEFENSE ACQUISITION EXECUTIVE (DAE) COORDINATES AND FORWARDS TO SEC FOR DECISION
* MILESTONE "I" SDDM ESTABLISHES WHEN NEXT MILESTONE SHALL OCCUR
* UPON APPROVAL, DOD COMPONENT MAY NECESSARY PROGRAMMING ACTION (PPB
* ESTABLISHES PROGRAM GOALS AND THRESHOLDS

THE ACQUISITION CYCLE



PHASE II
DEMONSTRATION/VALIDATION

- BUILD PROTOTYPES
- CONDUCT COMPETITION
- REFINE COST, SCHEDULE, PERFORMANCE and LOGISTICS PARAMETER ESTIMATES

MILESTONE II

* DECISION COORDINATING PAPER

  Need Assessment
  Threat Assessment
  Test Results
  Risk Assessment
  Acquisition Strategy

* DECISION BRIEFING

* REVISED PMD

PHASE III
FULL SCALE DEVELOPMENT

* DEVELOP COMPLETE SYSTEM

  Hardware
  Software
  Support Equipment
  Technical Orders
  Etc.

* CONDUCT COMPREHENSIVE TESTING

* PREPARE FOR PRODUCTION

MILESTONE III

* UPDATED DECISION COORDINATING PAPER

  Need Assessment
  Threat Assessment
  Test Results
  Production Readiness

* Decision Briefing

* Updated PMD

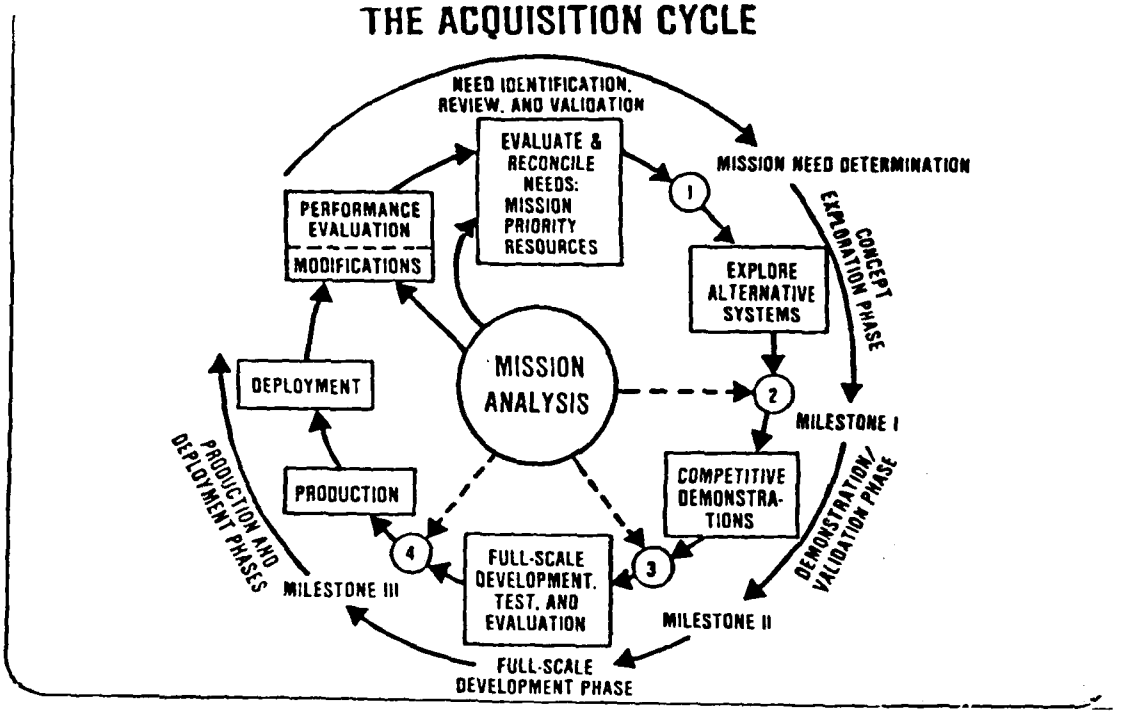
PHASE IV
PRODUCTION

* PRODUCE SYSTEM

* PRODUCE the SUPPORT SYSTEM

* PROGRAM MANAGEMENT RESPONSIBILITY TRANSFER (PMRT)

* FOLLOW-ON OPERATIONAL TEST and EVALUATION



NEW PROPOSED MILESTONES

* MILESTONE IV REVIEW

  Post Initial Operational Capability
  Actual Performance
  Actual Readiness and Supportability

* MILESTONE V REVIEW

  Current/Projected Requirements
  Major Upgrades
  System Replacement

LESSON 5

LESSON TITLE: **Planning, Programming, and Budgeting System** (*PPBS*)

TIME: 3 hrs

LESSON OBJECTIVE: The objective of this lesson is for each student to know the process by which USAF and DOD programs and budgets are developed and approved.

SAMPLES OF BEHAVIOR: Each student will be able to:

a. Describe the difference between planning, programming, and budgeting efforts.

b. List the three major resources defined by the Five Year Defense Program and the length of time each is projected.

c. State the principle phase of the PPBS to which the following documents relate:
   (1) Joint Strategic Planning Document (*JSPD*)
   (2) Program Objective Memorandum (*POM*)
   (3) Budget Estimate Submission (*BES*).

d. State the extent to which changes may be included in the Budget Estimate Submission.

e. Define Authorization and Appropriation.

f. Identify by appropriation:
   (1) obligation life span
   (2) time in expired status
   (3) how funds are identified in merged accounts.

TOPIC INTRODUCTION:

Planning, Programming, and Budgeting is probably one of the least understood areas in the acquisition arena. It is also one of the most publicized topics because of the annual authorization and appropriation process. Recent reform legislation, such as the *Packard Commission Report*, highlight the need for budget legislation reform and to make better *the way we do business*. As a program manager, you need to understand what planning, programming, and budgeting is and what goes into the Five Year Defense Program. After all, if you have program direction to start a program but do not have budget authority (the funds necessary to carry out that direction), you cannot award the contract. This lesson introduces the structure in which we implement budget requests, and the documents used in the planning, programming, and budgeting process.

METHOD OF INSTRUCTION: Lecture/Discussion

INSTRUCTIONAL MATERIALS:

a. Article, *Overview of the Planning, Programming, and Budgeting System*, by Mr McCarty, AFIT/LSY

b. *PPBS* videotapes

c. Lesson viewgraphs

AUDIO-VISUAL AIDS: Chalkboard

INSTRUCTIONAL EQUIPMENT: Video monitor and 3/4" tape player

REFERENCES:

a. *The Planning, Programming, Budgeting System* (PPBS) -- *A Primer*, published by DCS/Programs and Resources, HQ USAF/PRP

b. DOD Instruction 7045.7, *Implementation of the Planning, Programming, and Budgeting System* (*PPBS*)

REQUIRED STUDENT PREPARATION:

a. Read article: *Overview of the Planning, Programming, and Budgeting System*

b. Scan lesson viewgraphs

DISCUSSION QUESTIONS:

1. As an OSD staffer/programmer whose responsibility encompasses one sector of the GUSTO (Generally Unified Spheroid Treaty Organization) defense perimeter, you find references to numerous and varying threats in the official planning documents prepared by the Joint Staff. These threats underlie several new strategy recommendations. Many of those strategies are directly applicable to your area of concern. Your initial assessment is that to achieve all of them would require levels of research and development; weapons procurements; personnel movement, training, and "equippage" far beyond those approved in past budgets. Your most recent area assessment revealed no major or unexpected changes in *enemy* activities or capabilities. What actions would you take to develop your recommendations for the SECDEF's programming guidance?

2. The *Five Year* Defense Program (*FYDP*) identifies resources in three ways. What are those resource categories? Which resource is projected for more than five years in the FYDP? Why?

3. Discuss why the POM could be referred to as the "change agent" in PPBS.

4. What changes (to the POM submission) may be made in the Budget Estimate Submission (*BES*)? Give an example and explain why it would probably be an acceptable change.

5. Discuss the differences between an "authorization" and an "appropriation." Which allows an agency to obligate government funds?

6. Discuss the Gramm-Rudman-Rollings deficit limits and how the law dictates the achievement of spending reductions.

7. Discuss appropriation "life span" and what happens to an appropriation when its "life span" is complete?

[Acronyms introduced in this lesson, and their descriptions]

Chapter 5

DG	Defense Guidance
DNFYP	Department of the Navy Five Year Program
DOD	Department of Defense
DRB	Defense Resources Board
IP	Issue Paper
JPAM	Joint Program Assessment Memorandum
JSPD	Joint Strategic Planning Document
OMB	Office of Management and Budget
PDM	Program Decision Memorandum

PLANNING, PROGRAMMING AND BUDGETING SYSTEM

The Planning, Programming, and Budgeting System (*PPBS*) used in the DOD was introduced in the early 1960s by former Secretary of Defense McNamara. The system's principle purpose was to institutionalize planning and budgeting functions and to add a new function -- programming -- to provide a bridge between planning and budgeting. The PPBS is used to provide a Secretary of Defense-approved Five Year Defense Program. The first year of the FYDP is the budget year. Thus, the PPBS also provides DOD's input to the formulation phase of the federal budget process. The basic PPBS has withstood the test of time; it has survived as the resource allocation system under various secretaries of defense in both Democratic and Republican administrations.

Characteristics of the PPBS:

1. Provides the structure to coordinate a wide variety of management functions.
2. Serves up issues for decisions and records those decisions as they are made.
3. Establishes the role and functions of the principal military and civilian authorities in building the DOD budget.

The PPBS Process

The PPBS is an iterative process that involves three separate management phases:

A. *Planning.* Planning involves the systematic consideration of alternative actions to accomplish DOD objectives. The planning function provides the framework for subsequent DOD programming and budgeting actions in that it is primarily goal or output orientated. The objective in this phase is to identify strategies and capabilities which DOD must develop in order to support national security objectives.

B. *Programming.* Programming involves a review of the capabilities which DOD must develop, and subsequently attempting to program resources to match these strategies. The programming process then is a systematic review and consideration of the currently approved programs as expressed in the FYDP. However, some strategies may become infeasible when resources are considered. As a result, the programming process may involve some of the same activities as the planning process as priorities may have to be changed or strategies modified.

C. *Budgeting.* Budgeting is the process by which program decisions are translated into appropriations requests. Thus, it is the process by which we identify funding requirements for Congressional action. As with programming, budgeting is a function which sometimes involves elements of the preceding functions. As budget decisions are made, it may be necessary to reconsider strategies previously developed or to reschedule previously approved programs.

Overview

The PPBS cycle is the sequence of events used to accomplish these functions. The cycle is based on a calendar which provides major milestones beginning up to three years prior to the start of the fiscal year. Because this cycle consumes more than two years, an odd-year/even-year perspective is useful in developing some understanding of the process.

The PPBS cycle includes the following steps and data in arriving at a DOD budget submission:

ODD-NUMBERED YEAR

Step 1: *Joint Strategic Planning Document (JSPD)*. The JSPD provides to the SECDEF a statement of recommended military objectives derived from national objectives, and the recommended military strategy required to attain them. Included is a summary of JCS planning force levels which could execute, with reasonable assurance, the recommended strategies. Also included are JCS views on the attainability of the force levels. The JSPD is submitted to the SECDEF in early September and provides foundation for JCS recommendations on force planning guidance and changes to the DG.

Step 2: *Defense Guidance (DG)*. The DG, issued by the SECDEF in December, provides fundamental policy, strategy, issues, and rationale underlying the total defense program. The JCS, Services, and Defense agencies receive a draft DG in early October. It is intended that a dialogue occur between the Services, the JCS and the OSD staff before the issuance of the final version.

EVEN-NUMBERED YEAR

Step 3: *Program Objective Memorandum (POM)*. In April or May each military department and defense agency submits a POM to the SECDEF. The POM presents a prioritized program and includes baseline force levels, support and activity levels, and deployments within the stated constraints and fiscal levels of the DG. The POMs will include an analysis of each proposed change or new program. They express force, manpower, and cost implications (FYDP Update).

Step 4: *Joint Program Assessment Memorandum (JPAM)*. The JPAM provides the views of the JCS on the adequacy and capabilities of the total forces contained in the Service POMs to execute the national military strategy, and the risks inherent in those force capabilities. The JPAM includes the following:

--An assessment of the capabilities and associated risks represented by the composite POM forces.

--The JCS view on the balance of the recommended Service force and support levels.

--JCS recommendations on how to achieve improved defense capabilities within the alternate funding levels directed by the SECDEF.

--A mobility force analysis.

Step 5: *Issue Paper (IP)*. During the June-July period the SECDEF conducts a detailed review of the Service programs and makes decisions based on the POMs and Issue Papers. The IPs define specific issues for review by comparing the proposed program with the objective and requirements established in the DG. The papers present alternative resolutions for each issue and evaluate the merits of the alternatives, in terms of the DG fiscal constraints, and their ability to implement the missions set forth in the DG. Issue Papers are prepared in the following categories:

Nuclear Forces
Conventional Forces
Modernization
Intelligence
Manpower
Logistics and Readiness

Step 6: *Program Decision Memorandum (PDM)*. In late July or early August a PDM is issued by the SECDEF for each military department and defense agency. These PDMs summarize the initial program decisions of the current cycle based upon a review of the POMs, JPAM, and IPs. The PDMs are strongly influenced by the deliberations, recommendations, and decisions of the Defense Resources Board (*DRB*). They constitute budget guidance to the recipient organizations.

Step 7: *Budget Estimates.* In mid-September, each military department and defense agency submits its annual budget estimate to the SECDEF. The estimates are based upon the approved programs reflected in the POMs and PDMs. Specific detailed instructions for budget submissions are prescribed by OSD. Upon receipt of the budget estimates, the SECDEF directs a review by the OSD staff working with representatives of the Office of Management and Budget (*OMB*).

Step 8: *Budget Decisions.* In late October the first budget decisions will be issued. Departments, JCS, and agencies provide comments on an *as received* basis in order that the last budget decision may be issued by mid-December. Specific budget issues that arise may result in major issue meetings with the SECDEF.

Step 9: *DOD Budget Submission.* Late in December the completed DOD budget is sent to the Office of Management and Budget for review and presidential approval. When approved it becomes a part of the President's budget submitted to the Congress.

Step 10: *The President's Budget.* In January of each year the President submits a Unified Federal Budget to the Congress. While the President submits an annual budget for all other executive branch agencies, the DOD submission is biennial (January of the odd-numbered years). The even-year DOD portion of the President's Budget requests necessary budget adjustments to the second year of the DOD submission which was made the previous year.

The Defense Resources Board (*DRB*)

The Defense Resources Board (*DRB*) helps the SECDEF manage the entire PPBS. They review the proposed planning guidance, manage the program and budget review process, advise on PPB major issues and proposed decisions, and assure the alignment of major system acquisitions with available resources. DRB members represent the Services, the JCS and OSD staff functions. The DEPSECDEF is the Board Chairman.

The Five Year Defense Program (*FYDP*)

The FYDP is comprised of ten major defense programs which represents the mission and support responsibilities of the DOD. Each major defense program is subdivided into program elements whose mission characteristics are closely related. Programs are structured in terms of both mission objectives and supporting objectives. Each program therefore consists of as many program elements as necessary to provide total visibility to the mission and support functions of the program.

The FYDP is the officiai, formal written record of decisions that have been made in DOD. Its purpose is clearly defined in Department of Defense (*DOD*) Directive 7000.1. The directive states that the FYDP will contain DOD approved plans. The FYDP is identified as *the nucleus of Department of Defense resource management systems* and systems developed for resource management *will be consistent with it.* The FYDP is updated during the PPBS cycle to reflect the most current status of SECDEF or Presidential decisions.

Thus, the FYDP is the data base for all DOD approved plans, and its language and structure provide the framework for DOD resource management. The FYDP was developed to unify forces and missions and to be useful for all Military Departments and DOD agencies. The FYDP structure is aiso used to develop budget estimates based on approved forces and missions.

The following discussion explains the design and structure of the Five Year Defense Program, the data maintained in the FYDP, how the services supplement the FYDP, and how the FYDP satisfies the original criteria for its design.

Structure

This section explains how the Five Year Defense Program incorporates data on the DOD production process, including outputs, inputs, and processors.

Outputs

DOD Directive 7000.1 emphasizes that the Five Year Defense Program will contain *Department of Defense approved plans.* When organizations engage in planning, they are looking at the goals or objectives of the organizations. Goals or objectives are always expressed in terms of outputs. Since the FYDP was to contain DOD approved plans, its structure had to include output information.

Major Force Programs. Major Force Programs are general descriptions of DOD outputs. FYDP de'gners recognized that any attempt to describe DOD outputs with any degree of precision would result in a detailed and cumbersome structure which would be difficult to comprehend. Additionally, if the descriptions were too specific, it would be difficult to develop a presentation which unified the Military departments and DOD

agencies. Descriptions thus had to be very broad, and initially nine major programs were developed to describe outputs. Various modification have led to the current structure of ten major programs:

1) Strategic Forces
2) General Purpose Forces
3) Intelligence and Communications
4) Airlift/Sealift
5) Guard and Reserve Forces
6) Research and Development
7) Central Supply and Maintenance
8) Training, Medical, and Other General Personnel Activities
9) Administration and Associated Activities
10) Support of Other Nations

These programs are general enough to describe activities in which all elements of the Department of Defense are involved, yet they are specific enough that the terms are meaningful to FYDP users. For example, the term *Strategic Forces* would invoke images of an intercontinental weapons delivery capability. Within this major program, one would expect to find such specific capabilities as Air Force's long-range bombers and intercontinental missiles, and the Navy's sea-based missile systems. By defining outputs in this manner, DOD decision makers can review alternative means of achieving a capability with the analysis easily able to cut across service lines.

Program Elements. Program elements are subdivisions of Major Force Programs identifying a specific capability. While the Major Force Programs are useful general descriptors of DOD output, it was recognized that decision makers would need specific information on the weapons systems that contribute to the general capability. This specific information was to be identified with a program element, which would be a subdivision (or an element) of a Major Force Program. The program element is thus the basic building block for describing the output of the DOD. Every mission of the DOD must be incorporated into one of the ten Major Force Programs and, in turn, into one of the many Program Elements.

A Program Element is defined as *a combination of personnel, equipment, and facilities . . . [which] . . . constitutes a military capability or support activity.* Thus, within the Strategic Forces Major Force Program, one would find a Program Element identifying the B-1 capability and another Program Element identifying the PEACEKEEPER missile capability.[1]

It is obvious that these Program Elements provide a very specific description of the outputs of the Department of Defense. When the SR-71 program element is mentioned, for example, an image immediately forms of the high altitude reconnaissance aircraft and its capabilities. The subdivision into program elements provides flexibility for the DOD decision maker, in that program element may be aggregated in a wide variety of ways, depending upon the needs of the decision maker. The decision-maker need not rely solely on the Major Force Program grouping if a rearrangement of Program

[1]Note that there is one Program Element for the entire capability and not a separate Program Element for each B-1 or PEACEKEEPER squadron.

Elements is more appropriate for the alternatives being studied. Additionally, trade-offs can be analyzed comparing various *mixes* of forces within any Major Force Program.

Inputs

DOD Directive 7000.1 requires that the Five Year Defense Program contain a language such that . . . *budgeting . . . will be consistent with it.* Budgeting is a process to identify and obtain spending authority from Congress; thus, it focuses on what will be purchased with the spending authority (i.e., the inputs to the DOD production process). Since the FYDP needed to accommodate budgeting, its structure had to include input information.

Appropriations. Appropriations are permission to obligate the Treasury to pay money for goods or services. Appropriations are laws passed by Congress which authorize the obligation and expenditure of certain dollar amounts and which specify the purposes for which the funds may be used. In 1950, the number of appropriations was reduced from 2000 to 375, with each appropriation covering a broader range of items to be purchased. The Department of Defense annually receives approximately 85 appropriations which fall into the five general areas.

Military Personnel
Operations and Maintenance
Procurement
Military Construction
Research, Development, Test, and Evaluation

Each of these general areas represents several appropriations. For example, in the area of Operations and Maintenance, the Air Force alone receives three appropriations, one for day-to-day operations of the active duty establishment, one for operation of the Air National Guard, and one for operation of the Air Force Reserve. Altogether, there are 12-15 annual appropriations for operations and maintenance of DOD activities. Much as the Major Force Programs broadly describe outputs, the appropriation categories provide a very general description of inputs. These general descriptions, however, provide categories useful for Congressional review and decisions.

Processors

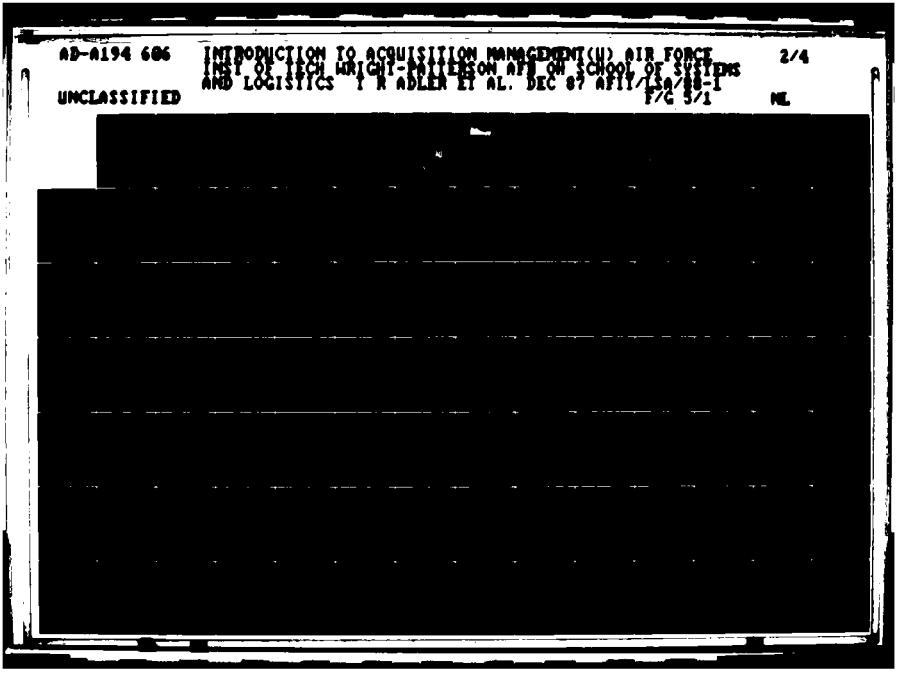
The conversion from inputs to outputs takes place in the organization responsible for the conversion. Since this organization is closest to the production process, its managers are responsible for identifying what inputs are required to produce the outputs. Additionally, they are responsible for the performance of their organization in producing outputs effectively and efficiently.

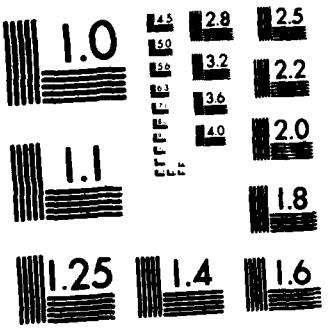
Military Department or DOD Agency. The Military Department or DOD Agency identifies which DOD organizational element will carry out the conversion process. With the FYDP data base maintained at DOD level, the organizational identification goes no lower than department or agency level.

Responsibility Center. A responsibility center is an organization headed by a manager who is assigned financial management responsibility and accountability and who, in most instances, exercises a significant degree of control over resource acquisition

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UNCLASSIFIED F/G 5/1 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

and consumption. Each Military Department or DOD Agency can be considered a responsibility center. Additionally, subordinates such as Major Commands, Wings, and Squadrons, will often also be responsibility centers. These subordinate units are not specifically identified in the Five Year Defense Program, but they may be identified in similar program data bases maintained by the department or agency.

FYDP Summary

The Five Year Defense Program identifies each piece of data using three separate classification schemes. The data are classified by input (appropriation), by processor (Military Department or DOD Agency), and by output (Major Force Program). The result is a matrix, so that the data can be accumulated along whichever lines are most useful to the decision maker.

Data

Because the Five Year Defense Program is a computerized data base, it is capable of retaining massive amounts of data. This section explains the nature of the data which are captured in the Five Year Defense Program, including the types of data maintained, the time frames for which the data are maintained, and the quantity of data maintained. The FYDP consists of data relating to program forces, personnel, and costs.

Program Forces. Force information identifies specific weapon systems by type and model and specific force organizations such as brigades and wings. As previously identified, the FYDP had to be useful to planners. Since planners deal primarily in terms of capabilities, it was necessary to include information on approved force levels. While the number of organizations and types of weapon systems are identified, the FYDP does not identify exact numbers of weapons systems. Quantities are, however, identified for new acquisitions. Thus, the FYDP may identify eight squadrons of B-1s programmed for FY 8X, but it will not identify the exact number of B-1s to be operational. It may, however, identify that seven B-1s are programmed to be acquired in Fiscal Year 8X.

Personnel. Personnel information identifies manpower requirements for active, guard and reserve personnel, cadets, and civilian employees. It is necessary to translate forces into input categories before identifying costs. Because governmental employment is of concern to national policy makers, this resource is the subject of extensive reporting requirements and controls. As a result, the personnel input is specifically identified in the FYDP data.

Costs. Cost information identifies the spending authority associated with DOD programs. The cost data are necessary for the budget and analysis processes and, thus, are included in the comprehensive FYDP data base.

Time Frames

The Five Year Defense Program might be expected to be a data base which covers five years into the future. This expectation is satisfied, but the FYDP contains much more data than just the five year projections.

Historical Data. The FYDP serves as a data base for DOD financial information retaining all data on DOD programs since the establishment of the FYDP in 1961. The

data can be used to analyze trends to assist with projecting future requirements. One major problem in developing such analyses is related to the fact that the FYDP structure has not been static. The FYDP began with nine major force programs, expanded to eleven, and now has been reduced to the ten programs mentioned earlier. As program definitions have changed, the alignments of program elements has changed. Additionally, new program elements are constantly being added as new capabilities are designed. Each of these factors hampers the ability to make valid comparisons using different years of historical data.

Projected Costs and Personnel. For development of resource projections, the FYDP is truly a five-year program because it retains cost and personnel projections for five years into the future. This data is termed *priced* data since it identifies quantities of input (i.e., prices) necessary to produce output.

Projected Forces. Since planners necessarily work on a relatively long horizon, the FYDP retains force projections for eight years into the future. This longer time frame is necessary to accommodate the long lead times often required for developing and acquiring new systems.

Quantity of Data

From the previous discussion, it is relatively easy to see why the Five Year Defense Program is a computerized data base. In January 1984 there were approximately 85 appropriations, 25 DOD components, and 2600 program elements (including historical). Since data covered the years 1961 through 1985, and included forces, personnel, and costs, the data base theoretically contained nearly a billion cells of information! In fact, the information retained is not quite that voluminous, because not every program element is associated with every DOD component, and because more than 800 program elements are no longer active. They are retained, for historical purposes only, with data no longer added (for example, the program element for B-47 squadrons). Almost half of the historical program elements are associated with research and development programs which are either no longer active (e.g., the XB-70 program element) or which have progressed beyond the research and development stage into operational programs (e.g., the F-15 program element in the research and development program is now historical, while the F-15 program element in the general purpose forces program is active).

General Uses

Because the Five Year Defense Program is the comprehensive data base for the Department of Defense, it is used to satisfy both internal and external information requirements. Some of these uses are identified in DOD Handbook 7045.7-H, *FYDP Program Structure:*

- -- Secretary of Defense Posture Statement
- -- Defense Manpower Requirements Report
- -- Defense Planning and Programming Category Reports
- -- Outyear outlay estimating
- -- Current/constant dollar conversions
- -- Mission-Oriented Resource Display
- -- DOD input to Defense Resource Model used for Congressional Budget Office analyses

Service Versions

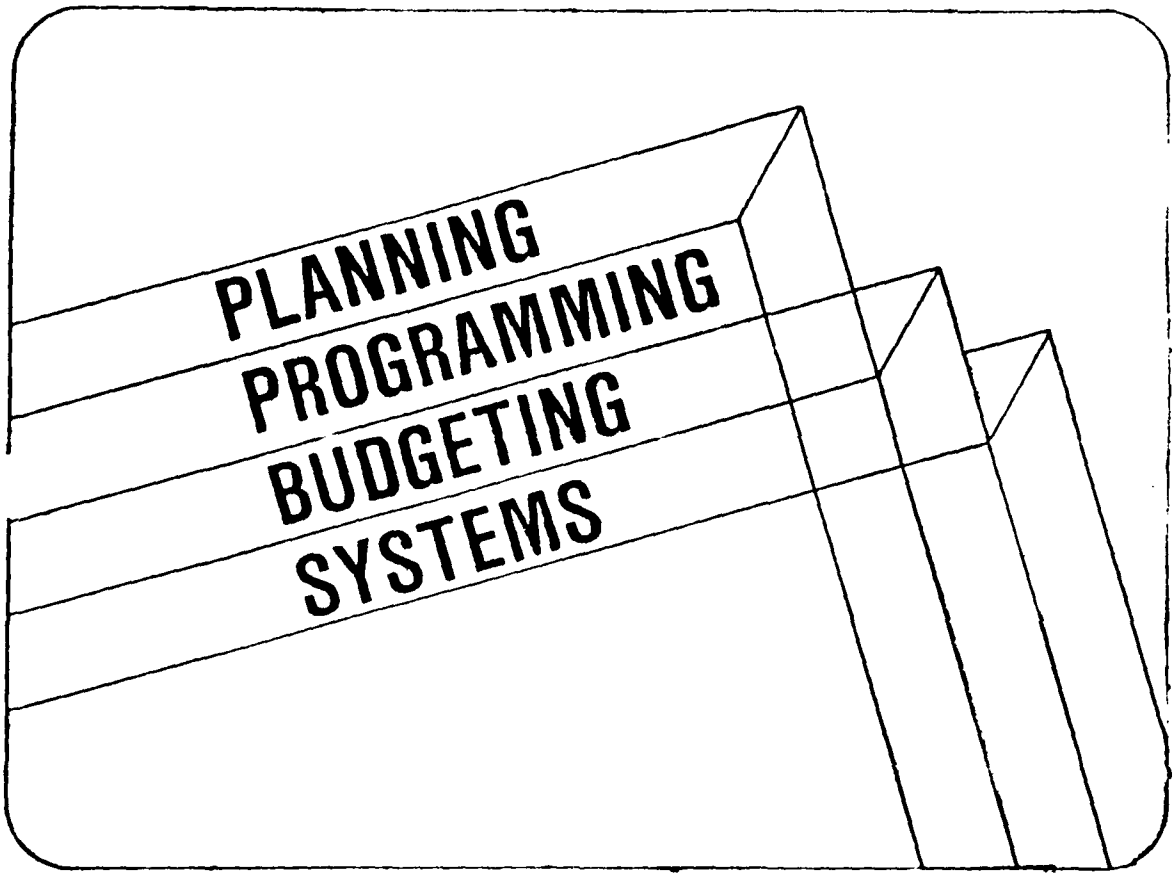
Each service maintains its own version of the programs within the FYDP which are managed by that service. Service organizational identifiers usually are carried to the Major Command level and expenditures are identified to detailed elements for expense. Service data bases similar to the FYDP are the *USAF Force and Financial Plan*, the *Army Five Year Defense Program*, and the *Department of the Navy Five Year Program* (*DNFYP*). Marine Corps requirements are identified in the *DNFYP*.

Development Criteria

The FYDP structure was designed to satisfy several criteria, and it has been successful in doing so. The structure was designed as an operating tool of DOD managers. The Program Element structure has enabled both the broad aggregations by Major Force Program and the detailed analyses by Program Element. In this way it is possible to develop presentations which are meaningful to different managers. Because programs cut across organizational lines, it is possible to review the operation of the entire DOD along mission (or output) lines instead of reviewing service-by-service. The structure also provides the framework for DOD resource management because it identifies: (1) input resources, (2) who is using them, and (3) what is produced with those resources. This is the type of information necessary for any performance measurement system and the FYDP structure provides the framework for DOD accounting systems.

Summary

The Five Year Defense Program is the comprehensive data base for the Department of Defense. It includes data on inputs (appropriations/elements of expense), processors (organizations/responsibility centers), and outputs (major programs/program elements). Data including forces, personnel, and costs is retained since 1961, with projections of personnel and costs for five years into the future, and force projections for eight years into the future.



THESE WERE THE GENERATIONS OF BUDGETING

BUDGETING BEGAT LINE ITEMS

LINE ITEMS BEGAT PERFORMANCE BUDGETING

PERFORMANCE BUDGETING BEGAT PROGRAM BUDGETING

PROGRAM BUDGETING BEGAT PLANNING-PROGRAMMING-BUDGETING

PLANNING-PROGRAMMING-BUDGETING BEGAT MANAGEMENT-BY-OBJECTIVES

MANAGEMENT-BY-OBJECTIVES BEGAT ZERO-BASE BUDGETING

ZERO-BASE BUDGETING BEGAT EVALUATION

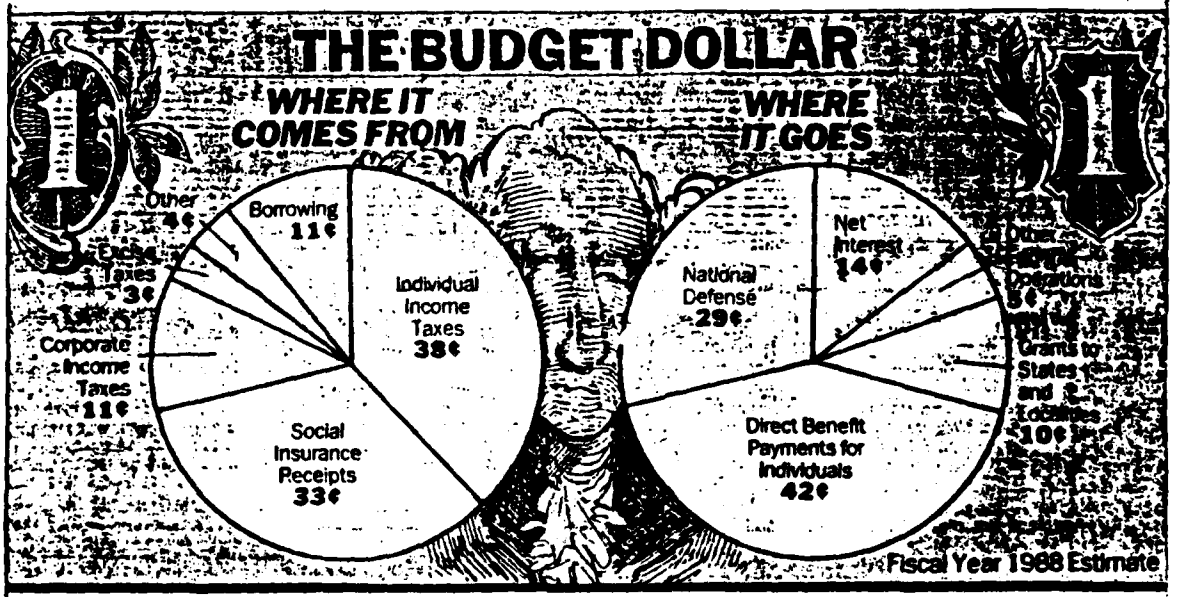
EVALUATION BEGAT EXPERIMENTATION

EXPERIMENTATION SHOWED THAT NOTHING WORKS

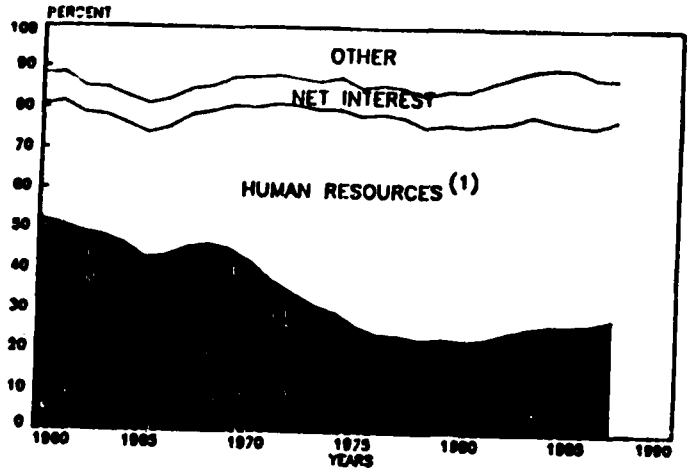
ALLEN SCHICK - "BUDGETING"

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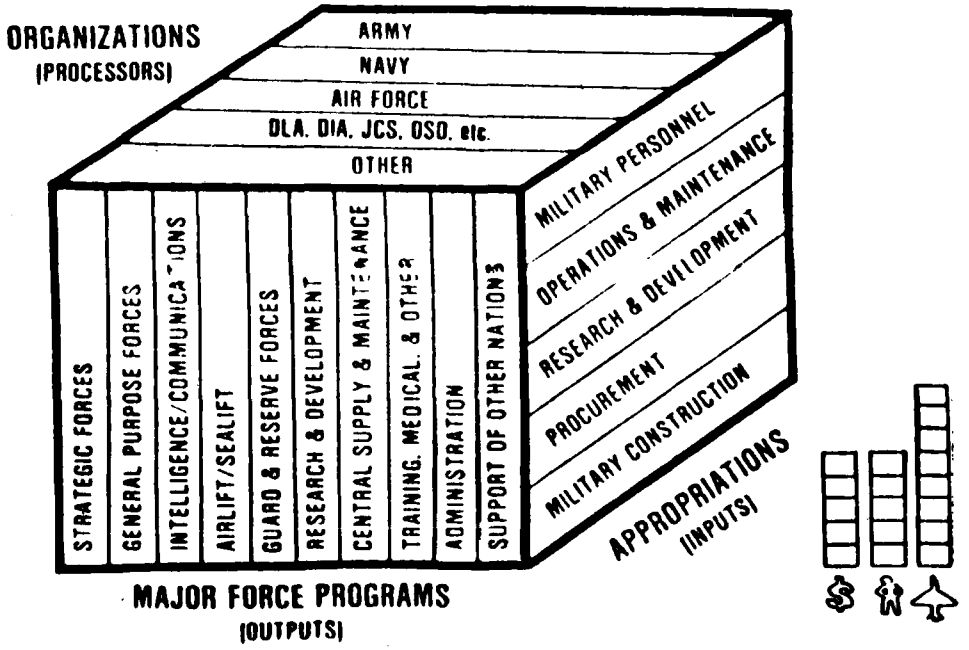


U.S. BUDGET OUTLAYS BY SUPERFUNCTION



(1) HUMAN RESOURCES:
EDUCATION, TRAINING, EMPLOYMENT, AND SOCIAL SERVICES, HEALTH, MEDICARE
INCOME SECURITY, SOCIAL SECURITY, VETERANS BENEFITS AND SERVICES.

FIVE YEAR DEFENSE PROGRAM STRUCTURE



PROGRAM ELEMENT

- IDENTIFIABLE MILITARY CAPABILITY OR SUPPORT ACTIVITY OR RESEARCH CAPABILITY
- COMBINATION OF PERSONNEL, EQUIPMENT AND INSTALLATIONS
- ALL PROGRAMS TOGETHER CONSTITUTE THE COMPLETE DEFENSE ESTABLISHMENT
- PURPOSE IS TO AGGREGATE THESE UNITS CONVENIENTLY FOR TOP-LEVEL DECISION MAKING

THE FIVE YEAR DEFENSE PROGRAM

- FOUNDATION OF DOD PROGRAMMING SYSTEM
- OFFICIAL APPROVED PROGRAMS FOR ALL DOD COMPONENTS
- BASE FOR SUBMISSION OF PROPOSED PROGRAM CHANGES

IT INCLUDES . . .

- FORCES, (equipment, facilities) FOR EIGHT YEARS AHEAD
- REMAINDER OF PROGRAM (personnel, costs) FOR FIVE YEARS AHEAD
- HISTORICAL DATA SINCE 1962

BUDGET AUTHORITY
DEFENSE, MILITARY
(BILLIONS OF DOLLARS)

MAJOR FORCE PROGRAM	BUDGET AUTHORITY			
	FY 86 ACTUAL	FY 87 EST	FY 88 EST	FY 89 EST
1. STRATEGIC FORCES (1)	24.2	21.5	23.7	27.7
2. GENERAL PURPOSE FORCES	116.2	117.2	118.8	126.8
3. INTELLIGENCE AND COMM	26.4	28.2	30.2	31.5
4. AIRLIFT AND SEALIFT	7.6	7.2	6.0	6.6
5. GUARD AND RESERVE	15.6	16.0	17.5	18.6
6. RESEARCH AND DEVELOPMENT (2)	25.7	28.0	35.1	36.5
7. CENTRAL SUPPLY AND MAINTENANCE	24.4	23.1	26.0	27.0
8. TRAINING, MED AND OTHER	33.6	36.3	38.8	41.0
9. ADMINISTRATION	7.1	6.7	6.3	6.7
10. SUPPORT OF OTHER NATIONS	.5	.7	.9	.9
TOTAL	281.4	284.9	303.3	323.3

SOURCE: BUDGET OF THE UNITED STATES, FY88 (OMB)

NOTES:

1. EXCLUDES STRATEGIC SYSTEMS DEVELOPMENT IN THE R&D CATEGORY.
2. EXCLUDES R&D IN OTHER PROGRAM AREAS ON SYSTEMS APPROVED FOR PRODUCTION.

BUDGET AUTHORITY
NATIONAL DEFENSE
(BILLIONS OF DOLLARS)

APPROPRIATION	FY86 ACTUAL	FY87 EST	FY88 EST	FY89 EST
MILITARY PERSONNEL	67.8	74.2	76.3	76.6
OPERATIONS AND MAINTENANCE	74.9	79.7	86.0	90.1
PROCUREMENT	92.5	85.8	84.0	94.6
RESEARCH DEVELOPMENT TEST & EVALUATION	33.6	36.7	43.7	44.2
MILITARY CONSTRUCTION	5.3	5.4	6.6	6.9
FAMILY HOUSING	2.8	3.1	3.5	3.7
REVOLVING FUNDS AND OTHER	5.2	.7	1.7	1.1
TOTAL	282.1	285.6	301.3	317.2
NWR (SEE NOTE 1)			2.7	6.8
	282.1	285.6	304.0	324.0
MINUS: PROPRIETARY RECEIPTS	.7	.7	.7	.7
TOTAL FUNDS UNDER DOD CONTROL	281.4	284.9	303.3	323.3
ADD: DEPT OF ENERGY AND OTHER DEFENSE RELATED ACTIVITIES (SEE NOTE 2)	7.3	7.5	8.1	8.5
	288.7	292.4	311.4	331.8

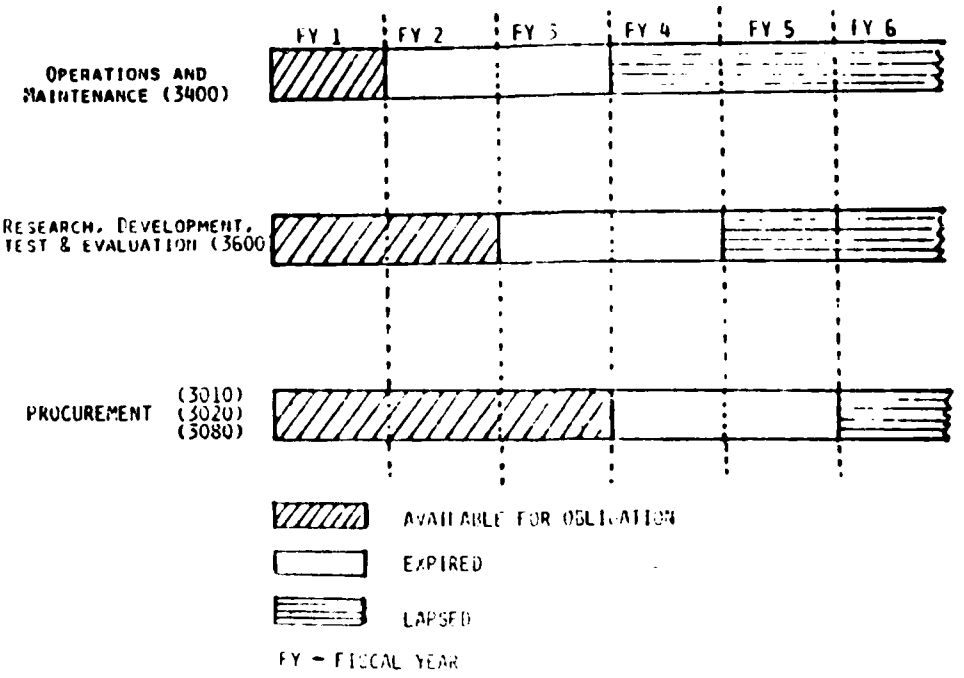
SOURCE: BUDGET OF THE UNITED STATES, FY88 (OMB)

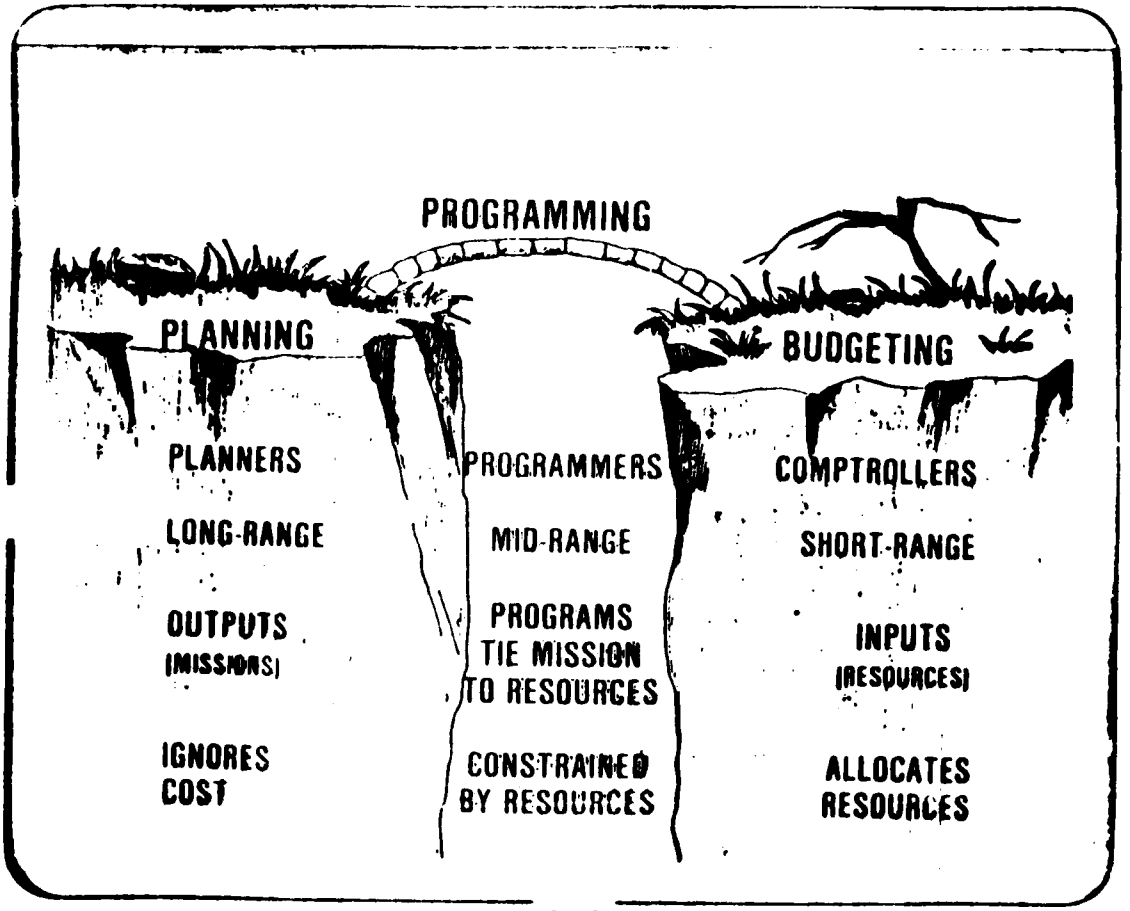
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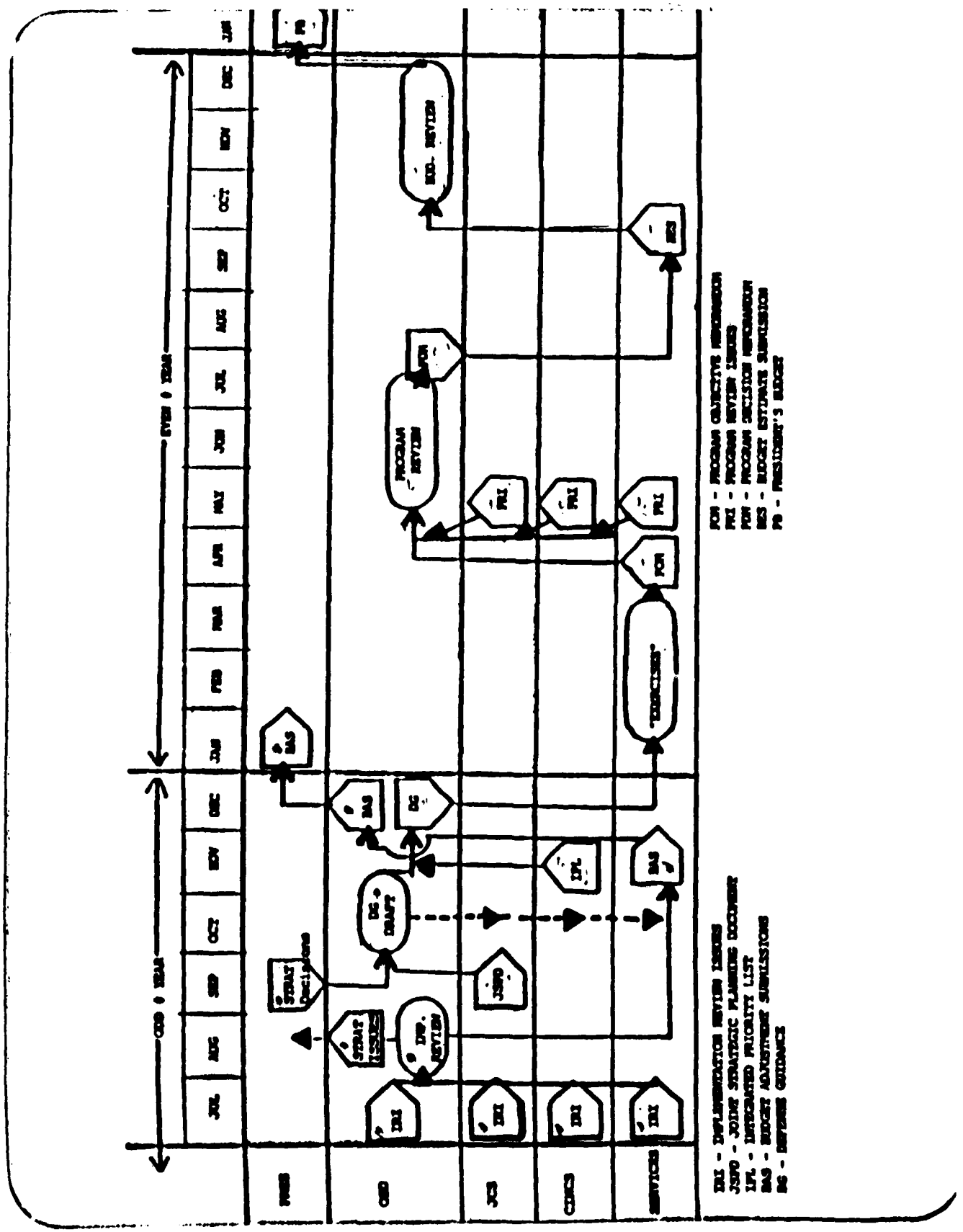
1. ALLOWANCES FOR MILITARY AND CIVILIAN PAY RAISES AND OTHER PURPOSES FOR FY88 AND FY89.
2. EXAMPLE - PRODUCTION OF NUCLEAR WEAPONS
   EXAMPLE - GSA REAL PROPERTY SUPPORT

APPROPRIATION STATUS

(FOR APPROPRIATION ACCOUNTS IN THE FY 1 APPROPRIATION ACT)







1974 CONGRESSIONAL BUDGET AND IMPOUNDMENT CONTROL ACT

- NEW ORGANIZATIONS CREATED
  - BUDGET COMMITTEES
    - ONE IN EACH HOUSE
    - LINKS REVENUE/SPENDING COMMITTEES
  - CONGRESSIONAL BUDGET OFFICE
    - PROFESSIONAL STAFF
    - ECONOMIC ANALYSES
    - SPENDING "SCOREKEEPER"
- NEW SUBMISSIONS
  - FIVE YEAR APPROPRIATIONS PROJECTIONS
  - MISSION BUDGETING
- CONTROLS ON IMPOUNDMENT
- ANNUAL MILESTONES

PLANNING . . .

- SELECTION OF COURSES OF ACTION THROUGH A SYSTEMATIC CONSIDERATION OF ALTERNATIVES

PROGRAMMING . . .

- MORE SPECIFIC DETERMINATION OF PERSONNEL, MATERIEL, AND FACILITIES NECESSARY TO ACCOMPLISH OBJECTIVES

BUDGETING . . .

- PRICING OUT APPROVED PROGRAMS
- OBTAINING FUNDS TO IMPLEMENT APPROVED PROGRAMS

LESSON 6

LESSON TITLE: **Solicitation Process**

TIME: 1 hr

LESSON OBJECTIVE: The objective of this lesson is for each student to know the purpose of the solicitation process, the major documents and participants involved in the process and their functions in the systems acquisition process, and the appropriateness of different types of contracts in various situations.

SAMPLES OF BEHAVIOR: Each student will be able to:

a. State the purpose of the solicitation process.

b. Describe the purpose of the following in the solicitation and acquisition process:
   (1) Acquisition Plan
   (2) Program Management Plan (*PMP*)
   (3) Work Breakdown Structure (*WBS*)
   (4) Statement Of Work (*SOW*)
   (5) Contract Data Requirements List (*CDRL*)
   (6) Specifications and Standards
   (7) Source Selection Plan (*SSP*)
   (8) Request For Proposal (*RFP*).

c. Describe the roles of the following in the source selection process:
   (1) Source Selection Authority (*SSA*)
   (2) Source Selection Advisory Council (*SSAC*)
   (3) Source Selection Evaluation Board (*SSEB*).

d. Describe the basic differences between fixed-price and cost-reimbursement type contracts.

TOPIC INTRODUCTION:

Now that you have a basic understanding of what an acquisition program is, who the important players are in meeting your program goals and objectives, and how the budget process is structured to support the financial management of funds, we need to get this all in writing with a contractor, to make something happen. The government has formalized procedures and policy on how to award a contract, as described in the Federal Acquisition Regulations (*FAR*), and implemented by each federal department. Of course, the Department of Defense supplements the FAR with regulations, called the DFAR, and the Air Force also supplements the FAR and DFAR to meet its particular requirements. This block introduces the basic building blocks in the solicitation process; the process of soliciting industry for proposals in meeting mission needs, program goals and objectives. There are important steps, in the solicitation process, that must be addressed and documented before we can solicit industry and award a contract. As program manager, you will probably be involved in this process, either in generating these documents, reviewing these documents, or supporting other solicitations.

METHOD OF INSTRUCTION: Lecture/Discussion

INSTRUCTIONAL MATERIALS:

a. Article, *The Solicitation Process*, by Capt Adler, AFIT/LSY
b. AFSCR 550-23, *Streamlined Source Selection*
c. *Solicitation* videotape
d. Lesson viewgraphs

AUDIO-VISUAL AIDS: Chalkboard

INSTRUCTIONAL EQUIPMENT: Video monitor and 3/4" tape player

REFERENCES:

a. Public Law 98-369, *Competition in Contracting Act (CICA)*
b. DOD Directive 4105.62, *Selection of Contractual Sources for Major Defense Systems*
c. AFR 70-15 (22 Feb 84), *Source Selection Policy and Procedures*
d. AFSCR 80-15 (31 Dec 74), *R&D Source Selection*
e. ASDP 800-7, *Source Selection Guide*
f. *Federal Acquisition Regulation (FAR)*, Parts 15, 16 & 17, 1984
g. *DOD FAR Supplement*, Parts 16 and 17, 1984
h. *Manual for Contract Pricing* (ASPM #1), 1986
i. *AFSCR 550-23, Streamlined Source Selection*

REQUIRED STUDENT PREPARATION:

a. Read article: *The Solicitation Process*
b. Read AFSCR 550-23, *Streamlined Source Selection*
c. Scan lesson viewgraphs

DISCUSSION QUESTIONS:

1. Describe how the Work Breakdown Structure can support program office tasks and contractor cost and schedule performance measurement.

2. You are the Program Manager for a major program entering into the Full-Scale Development phase. You are preparing for an upcoming competitive source selection so preparations are being made in support of this effort. What solicitation events and actions should be happening or should you be considering in support of the source selection?

3. Briefly describe what elements need to be considered in developing the RFP. Assume you have a non-major program that is transitioning into the Concept Demonstration/Validation phase.

4. Briefly describe the differences and commonalities in the Acquisition Plan, Program Management Plan, and other lower level program office plans.

[Acronyms introduced in this lesson, and their descriptions]

Chapter 6

CDRL	Contract Data Requirements List
CPFF	Cost-Plus-Fixed-Fee
CPIF	Cost-Plus-Incentive-Fee
DSSP	Defense Standardization & Specification Program
FAR	Federal Acquisition Regulation
FFP	Firm Fixed-Price
FPI	Fixed-Price Incentive
IFB	Invitations for Bids
ILSP	Integrated Logistics Support Plan
PCO	Procuring Contracting Officer
PMP	Program Management Plan
PR	Purchase Request
SOW	Statement of Work
SSA	Source Selection Authority
SSAC	Source Selection Advisory Council
SSEB	Source Selection Evaluation Board
SSP	Source Selection Plan
WBS	Work Breakdown Structure

THE SOLICITATION PROCESS

INTRODUCTION

The solicitation process is used by the Government to determine which contractor(s) are offering the best overall system in response to a government requirement. One of the prime reasons for having such a procedure is to insure that the government benefits from competition when only a few suppliers are capable of building a sophisticated weapon system. The source selection process is initiated, pending solicitation by the government, for acquiring services or product(s).

METHODS OF SOLICITATION

Invitation For Bids

The method of solicitation generally takes one of two major forms. If sealed bids are used, formerly called *Formal Advertising*, the solicitation instrument is called the Invitation For Bids (*IFB*). This method is quite rigid and inflexible in its implementation. It has its origin in a congressional enactment of 1809 which stipulated that *formal advertising would be required in the procurement of all supplies and services required by the Government when the situation is practicable and feasible.* The original purpose was to preclude granting special consideration to any individual or groups of individuals and to afford the Government the benefits of open competition. In the years to follow, there have been departures from this stringent method of procurement, particularly during periods of war, national emergencies or occasions wherein resort to formal advertising was inappropriate. In this respect, the FAR defines the situation as being practicable and feasible if it meets all of the following prerequisites:

(1) *Specifications.* To assure free and full competition there must be detailed specifications so that all potential bidders understand the requirement of the particular transaction. The specifications must be free of ambiguities, firm and not susceptible to unnecessary and frequent change.

(2) *Adequate Competition.* There must be a sufficient number of suppliers who indicate an interest in obtaining the contract.

(3) *Adequate Time.* There must be ample lead time from receipt of the program directive to the delivery date of the supplies or services.

(4) *Adequate Price Criteria.* Price and price related criteria must be *adequate contract award criteria.* If technical discussion is required, the sealed bid method cannot be used. Also, an IFB must result in a Firm Fixed Price type contract only. (In periods of high inflation a Fixed Price with Escalation type contract may also be used.)

Request For Proposal

However, the acquisition of defense systems (managed in the Air Force by Air Force Systems Command) generally does not satisfy these prerequisites and, therefore, uses the competitive proposals or *negotiation* method of procurement in which the Request For Proposal (*RFP*) is the solicitation instrument. This course will concentrate on the RFP

as the solicitation instrument. While the RFP's content is substantially the same as an IFB's, it does differ in certain notable respects. For instance, the RFP should preferably be written, but, in certain situations, (e.g., an emergency or other unusual circumstance) it may be in telephonic or telegraphic form. While specifications and/or drawings are preferable, they are not mandatory as is the case in sealed bidding. However, under normal conditions, where the negotiation method is utilized, the contracting officer, in preparing the RFP, must conform to all the requirements prescribed in the IFB (i.e., adequate distribution to qualified offerors and circulation of the RFP well in advance of the time set for the closing of the offer period).

ACQUISITION PLAN

Planning for release of an RFP to industry requires the government to complete several key documents before asking for contractor proposals. Federal policy, established in the Federal Acquisition Regulation (*FAR*), requires acquisition planning to begin as soon as an agency need is identified; preferably well in advance of the fiscal year in which contract award is necessary. This acquisition planning is consistent with the overall strategy for managing the acquisition and is usually documented in an acquisition plan soon after program direction is received and funding is approved. The acquisition plan serves a threefold purpose:

(1) To ensure the government meets its needs in the most effective, economical, and timely manner.

(2) To reduce acquisition risk by causing the acquisition planner to *think through* the acquisition process before the fact so that he is aware of the steps to be taken, activities to be integrated, problems to be resolved, and risks to be expected.

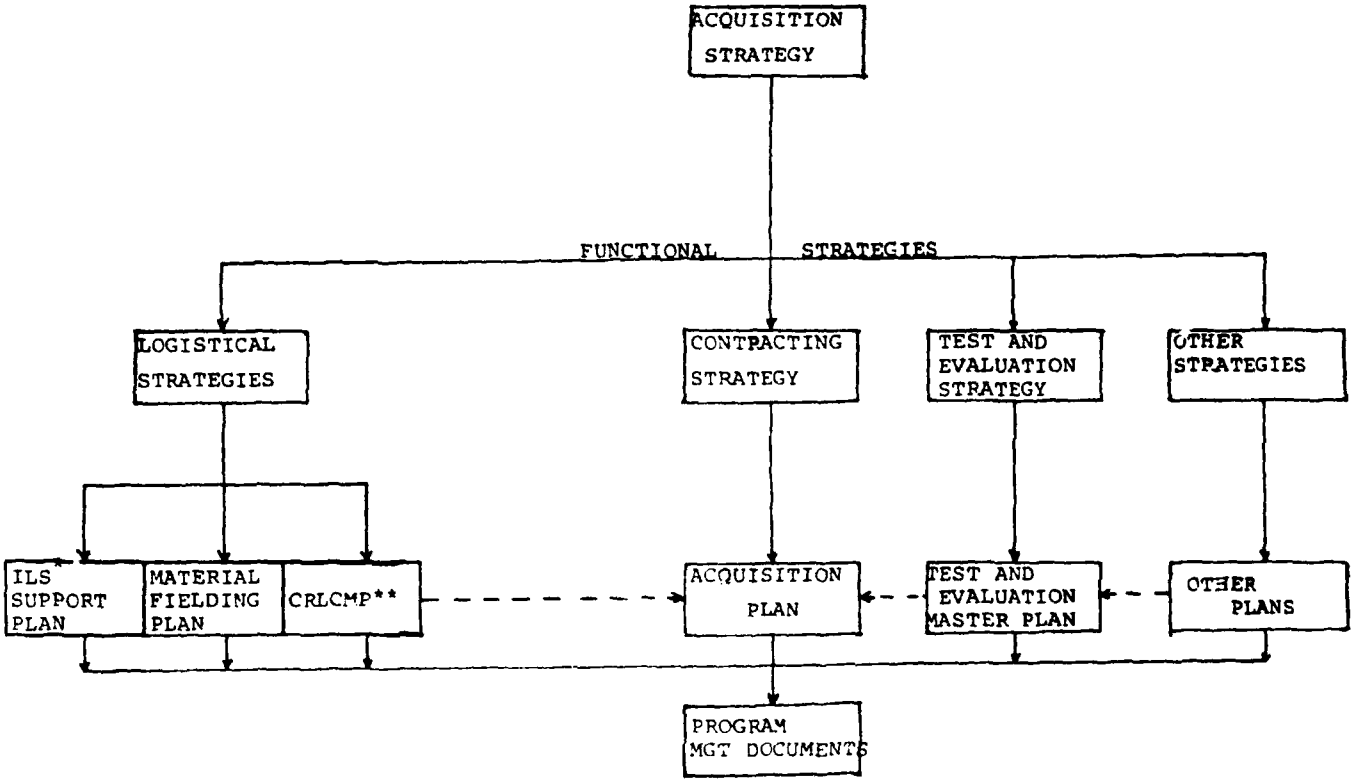
(3) To execute an effective integration of the various functional plans such as the System Engineering Master Plan, Integrated Logistic Support Plan, Test and Evaluation Master Plan, etc. (See Figure 6-1).

The acquisition plan serves as a *living document*, in that it *matures* or *evolves* over time, as more current information becomes available and relevant. Because of the evolutionary nature of the process, the FAR requires that the acquisition plan be reviewed and revised throughout the acquisition cycle.

PROGRAM MANAGEMENT PLAN

A similar document that needs to be reviewed and revised is the Program Management Plan (*PMP*). The purpose of the PMP is to unify the efforts planned and assist the program office, supporting command, and operating command personnel in working toward a common goal. As the thrust of the acquisition plan is to properly plan for subsequent government contracts with industry, the thrust of this plan stems from the acquisition strategy and encompasses all other aspects of the program. Thus, quite commonly, we will see acquisition plans written on an individual contract basis but certainly revised prior to each new phase of acquisition. The Procuring Contracting Officer (*PCO*) usually writes and maintains the Acquisition Plan. The program manager, however, has overall responsibility for the PMP. The

ACQUISITION PLANNING RELATIONSHIPS



*Integrated Logistics Support
**Computer Resources Lifecycle Management Plan

FIGURE 6-1

program manager must compile the PMP from inputs provided by program participants, including supporting and operating command personnel, and appropriate staff and functional areas. The PMP must provide the minimum essential information needed to outline the overall strategy for the program. Subordinate plans, such as the technical order master plan, maintenance plan, acquisition plan, support equipment acquisition plan, configuration management plan, and integrated communications support plan will develop details in the various functional and support areas. Program managers must coordinate the original (basic) PMP and, major revisions of, or additions to, the basic PMP over time. Coordination should be limited to only those offices directly affected by the plan. The basic PMP must be issued by the date specified in the Program Management Directive (*PMD*). It may be incrementally updated, depending on requirements and availability of information. An update must be made whenever a significant program change occurs, or at least yearly. Figure 6-2 contains a list of sections, by subject, for a typical PMP. Sections may be added or deleted as required. Each section must be concise and contain only essential details, usually in summarized form. Normally, planning or

implementing documents (like the acquisition plan) that contain details of functional activities need only be referenced in the appropriate section of the PMP.

SECTION	SUBJECT
1	Program Summary and Authorizations
2	Intelligence
3	Program Management
4	System Engineering and Configuration Mgt
5	Test and Evaluation
6	Information Systems
7	Operations
8	Civil Engineering
9	Logistics
10	Manpower and Organization
11	Personnel Training
12	Security
13	Directives, Specifications, and Standards

Figure 6-2

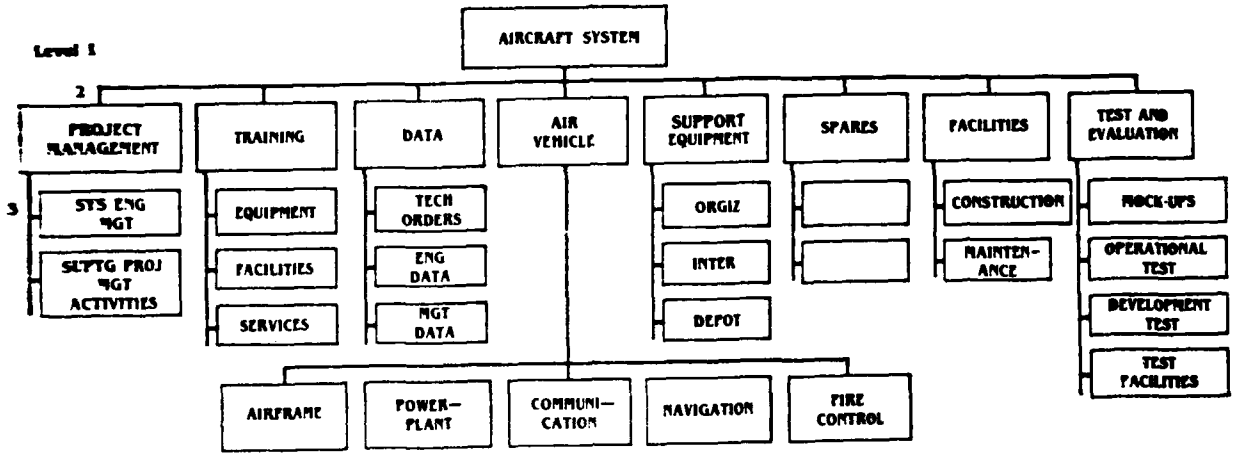
WORK BREAKDOWN STRUCTURE

The common thread that ties all plans and documents together is the Work Breakdown Structure (*WBS*). This is a product-oriented family tree composed of hardware, services, and data that result from project engineering efforts during the development and production of a defense material item or weapon system. MIL-STD-881A describes the WBS for use by both contractors and DOD components in the development of work breakdown structures for defense material items. Figure 6-3 contains an example of the upper three levels of an aircraft system that would be found in MIL-STD-881A. Most contractors manage their work according to a format similar to this, at whatever level is necessary to meet established schedules, and, that has been validated by the Defense Department. The Air Force will therefore manage contractor efforts according to information presented by the contractor in WBS format. There are four basic WBS formats highlighted in MIL-STD-881A, all of which could be applicable to a weapon system program:

(1) *Summary WBS* -- this WBS is nothing more than the upper three levels of the defense material item, or weapon system, taken verbatim out of MIL-STD-881A.

(2) *Project Summary WBS* -- once the Summary WBS is complete, unique program or project needs are determined through the systems engineering process, and the Summary WBS is appropriately tailored to best represent the program.

(3) *Contract WBS* -- the program office will structure a Contract WBS by selecting those elements of the Project Summary WBS that are applicable to the contractor, e.g., the contractor would be responsible for the avionics



SUMMARY WORK BREAKDOWN STRUCTURE

Figure 6-3

package of an aircraft but, possibly, not the spares or spare parts.

(4) *Project WBS* -- a compilation of all elements of the Project Summary WBS and Contract WBS necessary for project management and other related activities. The formal Project WBS will be completed prior to the initiation of production.

The WBS, in its several forms, is an extremely useful device as project/program managers engage in planning and controlling their programs. MIL-STD-881A is intended to be a guide. Rigid adherence to the formats is not required. A WBS, however, if sufficiently written, defines the program's total objectives; it relates the various work efforts (parts) to the overall product (whole system). The WBS is the foundation for:

(1) Program and technical planning.
(2) Statement of Work preparation.
(3) Schedule definition.
(4) Cost estimation and budget formulation.
(5) Progress status reporting and problem analysis.

STATEMENT OF WORK

With the WBS defined and developed, it is possible to prepare the Statement of Work (*SOW*). The SOW is a document that defines efforts to be accomplished

ranging from small research studies to the acquisition of a major weapon system. It establishes non-specification tasks/requirements and identifies the work effort. The SOW is a tasking document that defines the scope, or outer limits, of the contractor's effort. The SOW is part of the RFP and the contract. There are three sections in the SOW format:

(1) Section 1 -- (Scope).
(2) Section 2 -- (Applicable Documents).
(3) Section 3 -- (Requirements).

The SOW is a key element of the RFP and serves as a basis for contractor response and, subsequent government evaluation of proposals in source selection. After contract award, requirements of the work statement (and associated specifications) constitute the standard and discipline for the contractor's effort. It comprises the baseline against which progress and subsequent contractual changes are measured. Both parties, the government and the contractor, will look to the language of the SOW as a key document, defining responsibilities of the contractor and the government.

CONTRACT DATA REQUIREMENTS LIST

Directly related to the SOW is the Contract Data Requirements List (*CDRL*). The CDRL is a list of data requirements that is authorized for a specific procurement and is made part of the contract. The CDRL is one of the two places in the contract that can establish a requirement for the contractor to deliver data. The other area is by specific contract clauses, formerly called the general provisions section of the contract, which brings in Federal Acquisition Regulation clauses applicable to your contract. Both the CDRL and the clauses require Office of Management and Budget control over the data being collected, as regulated by the Paperwork Reduction Act (Public Law 96-511). CDRL data may best be thought of as data directly linked to SOW tasks. (See Data Management section for more information.)

DEFENSE STANDARDIZATION AND SPECIFICATION PROGRAM

Also important in the solicitation process, and included in most government contracts, are specifications, standards, and related documents. These are documents that are part of the Defense Standardization and Specification Program (*DSSP*) that establish and define requirements for purchased material, processes, procedures, practices, methods, and data. Specifications are documents prepared specifically to support acquisition and cover items which vary greatly in complexity. They establish essential requirements in terms of complete design details or in terms of performance, but most instances in terms of both design and performance. Specifications should establish requirements in terms of performance in order to permit solicitations of competitive bids from the largest segment of industry.

Standards, on the other hand, are documents that establish engineering and technical requirements for processes, procedures, practices and methods that have been adopted as standard. They are created primarily to serve the needs of designers. Their purpose is to control variety, and they include materials, items, engineering practices, processes, codes, symbols, type designations, definitions,

nomenclature, test, inspection, packaging and preservation methods and materials, and other standardization topics.

Other related documents include drawings or handbooks. A handbook is a reference document which brings together procedural and technical, or design, information related to commodities, processes, practices, and services. Drawings are referenced in many standardization documents and supply management records. Conversely, specifications and standards are often referenced in drawings to identify the materials, processes and standard items incorporated in assemblies and equipment.

The Air Force decision process (or what to put in a contract) for specifications, standards, and other related documents is a three step process:

(1) the selection from the total realm of available documents, those documents that have a specific application to a particular acquisition program.

(2) the selection of the specific applicable requirements in these documents.

(3) an examination and tailoring of the selected requirements so that each document imposes the optimum set of requirements to support the particular system during its acquisition and ownership.

PURCHASE REQUEST

Another important solicitation document is the Purchase Request (*PR*). A PR is a funding document used to initiate procurement action. The PR is a direct cite document which means that, before a contract can be awarded, there has to be authorized funding available in order to obligate the government for work performed. The PR is usually initiated after the SOW, CDRL, and specifications are complete. The PR is important in determining the dollar magnitude, advertising, competition, and scope of the intended source selection and contract award.

SOURCE SELECTION PLAN

The Source Selection Plan (*SSP*) usually provides a subsequent smooth, efficient source selection process in competitive solicitations. The SSP establishes procedures for accomplishing three prime objectives:

(1) to select the source whose proposal has the highest degree of realism and credibility and whose performance is expected to best meet government objectives at an affordable cost.

(2) to ensure impartial, equitable, and comprehensive evaluation of competitors' proposals and related capabilities.

(3) to maximize efficiency and minimize complexity of solicitation, evaluation, and the selection decision.

Prior to the issuance of an RFP, a SSP shall be approved by the Source Selection Authority (*SSA*), the government official in charge of selecting the source. The program manager is responsible for drafting the plan and obtaining its approval from the SSA. The SSP should complement the acquisition plan and should summarize the overall acquisition strategy contemplated for the program. The SSP

should include a discussion of the extent of competition contemplated, a description of the evaluation techniques to be used, and the schedule for significant actions required between the designation of the SSA and signing of the definitive contract. Also included in the SSP is a description of the organizational structure to be used in the source selection process. The organization is normally composed of three levels; the SSA, the Source Selection Advisory Council (*SSAC*), and the Source Selection Evaluation Board (*SSEB*). The SSAC is a group of senior military and/or government civilian personnel designated to serve as the staff and advisor to the SSA during the process. It reviews the SSEB findings, prepares a proposal analysis of each offer, and compares the proposals to one another. The SSAC is the body that considers the contractor's past performance.

The SSEB is a group of military and/or civilian personnel, appointed by the SSAC, representing various functional and technical disciplines. Their task is to evaluate proposals against established criteria, not proposals versus proposal, and to develop summary facts and findings during the source selection process. The SSEB is the heart of the selection team. The manning would typically include personnel from logistics, cost analysis, operational, contract, legal, and technical areas.

TYPES OF CONTRACTS

The FAR usually requires that contracting officers prepare written solicitations, (the RFP) and resulting contracts, using the uniform contract format outlined in FAR 15.406-1. The uniform contract format, shown in Figure 6-4, is designed to facilitate preparation of both the solicitation and the resulting contract. Sections A through J (Parts I-III) contain documents that, in effect, constitute a draft or *model contract.* In fact, the purpose of structuring the RFP this way is to provide basic documentation that will eventually form a major part of the resultant contract. The remaining sections (Part IV) in the uniform contract format are important parts of the RFP, but are not physically included in the resulting contract.

The result of the solicitation and subsequent source selection process is a mutually agreed upon contract for acquisition of supplies and/or services. This mutually agreed upon contract will be one of two basic types of contract categories in Air Force acquisitions: cost-reimbursement contracts and fixed-price contracts. With cost-reimbursement type contracts, the government is required to reimburse the contractor for all allowable, allocable costs, reasonably incurred in contract performance, up to the amount originally negotiated for contract performance. Once the funds run out, the contracting officer authorizes additional funding, if available, and, if the government decides to do so. Since the original contract price was predicated on an estimate, the contracting officer can provide additional funding without receiving new consideration from the contractor. Thus, the cost-reimbursement type contract allows the government considerable flexibility (at additional cost) in redirecting the contractor's efforts, within the scope of the contract, in response to changes in technology or mission requirements.

The major difference between fixed-price and cost-reimbursement contracts is that, with fixed-price contracts, funding of cost overruns and cost growth beyond a firm fixed-price (or ceiling price) is legally impossible. The contractor is obligated to

UNIFORM CONTRACT FORMAT

PART 1 - THE SCHEDULE		
Section A	Solicitation/Contract Form	
B	Supplies or Services and Prices/Costs	
C	Description/Specifications/Work Statement	
D	Packaging and Marking	
E	Inspection and Acceptance	
F	Deliveries or Performance	
G	Contract Administation Data	
H	Special Contract Requirements	
PART 2 - CONTRACT CLAUSES		
I	Contract Clauses	
PART 3 - LIST OF DOCUMENTS,EXHIBITS,ATTACHMENTS		
J	List of Attachments	
PART 4 - REPRESENTATIONS AND INSTRUCTIONS		
K	Representations, Certifications, Statements	
L	Instructions, Conditions, Notices to Offerors	
M	Evaluation Factors for Award	

MODEL CONTRACT

FIGURE 6-4

deliver a specified end-product at the contractual price, regardless of the actual cost. If the contractor's actual costs are lower than the estimates used to establish the agreed-on price, the contractor makes more profit.

These two categories of contracts, cost-reimbursement and fixed-price, fall along a risk spectrum reflecting the varying cost risk borne by the contractor and the government. At one end of the spectrum is the Firm Fixed-Price (*FFP*) contract, where the contractor bears the maximum cost risk. The FFP contract is most appropriate when reasonably definitive design or performance specifications are

available, such as, for the purchase of standard or modified commercial items, standardized military items, or acquisitions in the production phase. The government's ability to obtain an FFP contract is directly related to the contractor's ability to objectively estimate anticipated costs. If the uncertainties of contract performance can be identified and their impact on costs reasonably estimated, the contractor will be willing to accept a contract on an FFP basis.

At the other end of the spectrum is the Cost-Plus-Fixed-Fee (*CPFF*) contract, where the fee is fixed, and the government pays all of the contractor's actual costs, which are allowable and allocable up to a maximum price. The CPFF is most appropriate when estimates of cost, performance, and schedule involve large technical uncertainties and when both the contractor and the government desire to retain as much flexibility and opportunity for change as possible, such as in the concept exploration or demonstration/validation phase. With the CPFF, the contractor bears the minimum cost risk. There are numerous other types of contracts, like Fixed-Price Incentive (*FPI*) or Cost-Plus-Incentive-Fee (*CPIF*), that fall between the risk associated with the FFP and CPFF, but these are all basically derivatives of the FFP and CPFF concept, depending on the risk associated with that contract.

SUMMARY

The RFP, then, is the vehicle the government uses to ask industry for proposals for a system using the competitive proposal procurement method and is one of the most important documents in the acquisition cycle. All of the preparation and planning for an acquisition goes into the RFP as the key communication to potential contractors on exactly what, how, and when the government needs to buy. When the government issues an RFP, it is describing its needs for particular goods or services, and is soliciting, from industry, proposals to fulfill those needs. Competitors (or offerors) submit proposals (or offers) in response. Subsequently, the government conducts a source selection, negotiates with the winner, and the contracting officer signs (accepts) to form a binding contract. Lesson 7 will cover this area more in-depth. The RFP has particular significance in this process, in that the clarity and coherence with which it is constructed can dramatically affect the events that follow -- favorably or unfavorably. How well the government clearly communicates its needs in the RFP, for instance, will almost certainly influence the quality of proposals received, ease or difficulty of conducting source selection and negotiation, and, ultimately, relative success or failure of contract performance.

DEPARTMENT OF THE AIR FORCE
Headquarters Air Force Systems Command
Andrews Air Force Base DC 20334-5000

AFSC REGULATION 550-23

28 July 1987

Commander's Policies

STREAMLINED SOURCE SELECTION

1. Increasing leadtimes threaten our ability to be responsive to our users and our drive to maintain acquisition excellence. It is imperative that we take every action available to reduce the amount of time necessary to complete our contractual arrangements. The use of streamlined procedures in source selections has the potential to significantly reduce leadtimes without jeopardizing the time-tested integrity of our comprehensive source selection process. Therefore, I expect you to incorporate the philosophy outlined below to the widest possible extent across our acquisitions.

a. Ensure you maintain challenging goals for all parties involved in the source selection process. You should strive to complete the source selection process from Request for Proposal (RFP) release to source selection decision in 120 days.

b. Use draft RFPs to the maximum extent possible. They are a valuable tool that can pare requirements to the bare essentials and reduce proposal preparation and evaluation time.

c. Limit, whenever possible, the documentation requirements. The processing of source selection documentation has become too lengthy a process and we must constantly look for ways to shorten this process. Therefore, I am eliminating the requirement for contract strategy papers. I expect you to take similar action to reduce local coordinations and approvals to the minimum essential while eliminating duplicative and time wasting processes, including extensive prebriefings and "dry runs."

d. Limit the size of proposals. The quality of information contained in contractor proposals is far more important than the quantity. Technical and management volumes should each be limited to 100 double-spaced pages. Cost proposals should also have 100 pages as a maximum goal; although at times, it may be necessary to exceed that number to meet the requirements of existing public law. Limits are also important for responses to deficiency notices and clarification requests.

e. Make use of oral presentations from offerors to provide an overview of each proposal after initial evaluations. This procedure can both expedite the evaluation and improve the effectiveness of the source selection team.

f. Encourage the electronic submission and update of cost proposals. It saves time, greatly reduces misunderstandings, and will provide a major impetus to the improvement of the information available for pricing proposals.

g. Keep evaluation factors to the minimum necessary for selection. There are many things we can review, but it is essential to focus our limited resources on those things we *must* review.

h. Establish small, expert evaluation panels composed of key people with broad experience. Make effective use of the expert members of the Source Selection Advisory Council (SSAC). They can not only provide excellent and timely advice but they also can resolve potential showstopper issues within the organizations they represent.

i. Carefully determine the need for audit and field pricing support. If an audit is not required, it should not be requested. When an audit or field pricing support is required, it should be tailored to meet the needs of the individual source selection.

j. Assess each proposal realistically and carefully before inclusion in the competitive range. With contractor bid and proposal funds limited and our evaluation resources constrained, we must ensure that only proposals that have a reasonable chance for selection are included in the competitive range.

k. Use past performance as a key determining factor of present capability and give it a high priority when prescribing evaluation factors in solicitations. Careful consideration of past performance by the SSAC and Source

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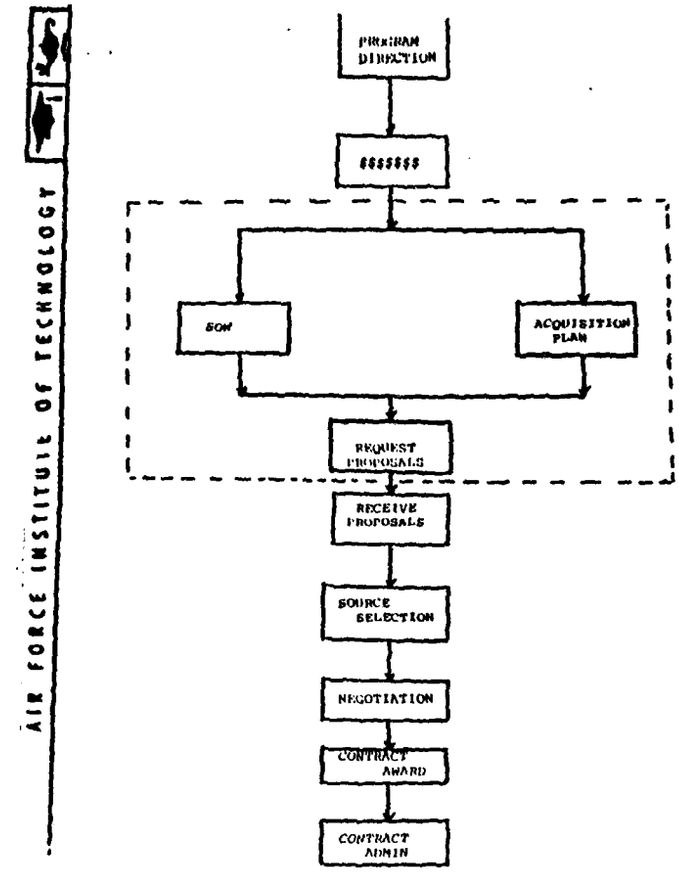
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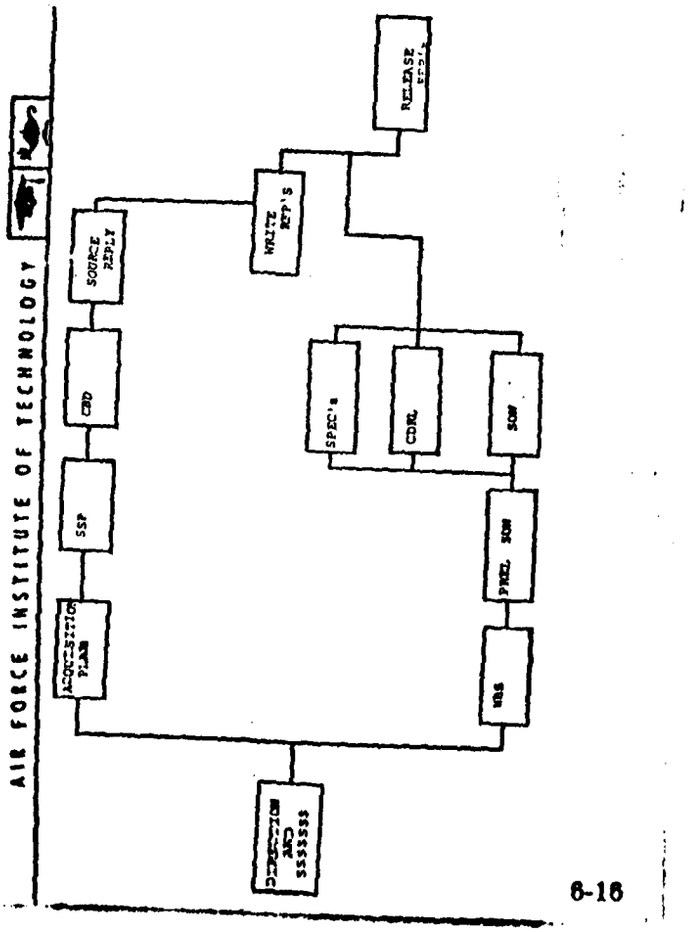
Selection Evaluation Board (SSEB) is a critical contributor toward improvement in contract selection and performance.

2. We have established an outstanding process for selecting our contractors, one that has proven its efficacy many times. Implementing this policy will provide improvements in the timeliness and overall efficiency of this process and will contribute significantly to our goal of acquisition excellence. Keep in mind that our purpose is to select the best contractor with a *good and demonstrated* track record. I want you to use every possible innovative, legal, and appropriate tool to make this happen. Do not engage in "square filling" or "cover your six" actions. Do not encourage "brochuremanship!" We are here to get what the user needs and to protect the taxpayers' interests, not to make ourselves look good for checkers and inspectors. Comprehensive and fair source selections are critical items for this Command, and I expect your full support and attention to this important element of acquisition excellence.

BERNARD P. RANDOLPH, General, USAF
Commander

AFSC – Andrews AFB DC 1987


AIR FORCE INSTITUTE OF TECHNOLOGY
PROGRAM DIRECTION
$$$$$$$
SON
ACQUISITION PLAN
REQUEST PROPOSALS
RECEIVE PROPOSALS
SOURCE SELECTION
NEGOTIATION
CONTRACT AWARD
CONTRACT ADMIN


AIR FORCE INSTITUTE OF TECHNOLOGY
RELEASE RFP'S
WRITE RFP'S
SOURCE REPLY
CRD
SSP
ACQUISITION PLAN
SPEC'S
CDRL
SOW
PWBS SOW
WBS
DEFENSE ACQUISITION $$$$$$$$

LESSON 7

LESSON TITLE: **Contract Management**

TIME: **2 hrs**

LESSON OBJECTIVE: The objective of this lesson is for each student to know the role of contracting personnel in the program office and the environment in which government contracting officers must function.

SAMPLES OF BEHAVIOR: Each student will be able to:

a. Describe the reasons which may disqualify a contractor for contract award.

b. List and describe the responsibilities of the three types of contracting officers.

c. Define the term *contract* and identify the elements that must be included.

d. Define the term *agency* and describe how it relates to Government contracting.

e. Identify the functions performed by the Contract Administration Office.

TOPIC INTRODUCTION:

The previous lesson talked about the solicitation process and some of the important documents which must be addressed to support the competitive proposal method of solicitation (the one most frequently accomplished in Department of Defense acquisitions). This lesson addresses activities from a different angle. The first videotape addresses the overall environment of the solicitation, and the source selection process, up to contract award. Emphasis here is on the contractor's proposal which is analyzed by the government, to make sure it's responsive and timely, is reasonable, and whether the contractor is a responsible contractor. In describing the steps that lead to contract award, the contracting officer's authority is also addressed, with regard to the three types of contracting officers and their basic responsibilities. The second videotape covers the organizations responsible for administering government contracts, and what types of information they can supply you with, in managing your program.

METHOD OF INSTRUCTION: Lecture/Discussion

INSTRUCTIONAL MATERIALS:

a. Article, *Contracting Authority*, by Maj Sand, AFIT/LSP

b. *Contract Management* videotape

c. Lesson viewgraphs

AUDIO-VISUAL AIDS: Chalkboard

INSTRUCTIONAL EQUIPMENT: Video monitor and 3/4" tape player

REFERENCES:

a. *Federal Acquisition Regulation (FAR)*
b. *DOD Far Supplement* (DOD FAR SUPP)
c. *Defense Acquisition Regulation (DAR)*
d. AFR 110-9, *Procurement Law*
e. ASPM #1, *Manual for Contract Pricing*
f. AFR 70-1, *Do's and Don'ts of Industry Regulations*
g. AFR 70-1-5, *DOD/NASA Incentive Contracting Guide*
h. AFSCR 70-7, *AFSC Procurement Evaluation Panel*

REQUIRED STUDENT PREPARATION:

a. Read article: *Contracting Authority*
b. Scan lesson viewgraphs

DISCUSSION QUESTIONS:

1. Ima New, the ACO, had been with the government just over one year. Until this time he relied heavily upon the vast experience of Good-Old Boy when making decisions which affected the contractor. During the morning coffee break Ima overheard Good-Old Boy bragging that he had earned his pay already that day by directing the contractor to do work not covered by the contract; further, this contractor was so naive that Good-Old Boy was certain that the contractor would not complain.

a. What alternatives does Ima have?
b. Which alternatives would you pick? Why?
c. What additional factors would cause you to select a different alternative?

2. An enforceable contract requires valid consideration. How do we determine if it exists? How much is enough? Who decides?

3. Discuss the factors which establish and bound the ACO's authority.

4. Discuss "agency" as it pertains to government contracts.

5. Mr. E. Z. Mark, the ACO, plays golf with Mr. N. O. Good, an influential contractor, every Saturday at the Swank Country Club. Mr. Mark and Mr. Good are each keenly aware of the government standards of conduct and they do not discuss business

while golfing. Mr. Double Standard, a competitor of Mr. Good, complains to you, the supervisor, that Good is receiving preferential treatment from Mr. Mark. What will you do? Why?

6. Mr. I. N. Eppt was assigned as the ACO for contract F33675-XO-C-6666. This contract required delivery of 2,500 cluster bomb dispensers to be used on both manned and unmanned aircraft. During the pre-production review, it became apparent Mr. Eppt had ignored the advice of his production and quality assurance specialists, and successful completion of the contract was in serious jeopardy. When confronted with this situation, the CO Mr. Omni Force, was tasked by the program manager to take any and all actions required to correct the situation.

a. What alternative(s) does Mr. Force have?

b. Which alternative(s) would you select? Why?

c. What additional information would you obtain before taking action?

7. Mr. I. M. Portant is the Program Manager for *Mister big*, a multifaceted state of the art weapon system initiated to negate the chemical warfare capacity of the most belligerent adversary of the US. Mr. Portant is convinced that successful program completion depends upon his personal involvement as the ACO.

a. Is this action possible?

b. How could Mr. Portant best assure that contract administration is accomplish in a satisfactory manner?

8. Mr. Cal Q. Lator, Chief, Engineering Service at DCASMA, Any City, was overwhelmed by his own importance. When communicating with Ms. Ima Slugg, the ACO, Mr. Lator would use "engineering-ese" to enlarge his role in even the most insignificant of circumstances. Ms. Slugg has previously appealed without success to the DCASMA Commander to correct Mr. Lator's attitude. You have now replaced Ms. Slugg. How would you deal with Mr. Lator?

9. Mr. John T. Flexible, recently the CO for a major weapon system has been reassigned to DCASMA, Nowhere City, as an ACO. You are his new supervisor. What topics would you cover, during his inbriefing, to ease his transition?

10. You are the ACO for a rather large, complex contract. The postaward orientation conference is to be held right after this meeting. What would you discuss? Whom would you invite? Under what conditions would you decide to cancel the postaward orientation conference?

11. Mr. Wiley Foxx was the Program Manager for the Snake-Eye Radar System. The contractor was experiencing difficulties with production of the system. Wiley sent Mr. Harry Wolf, his production expert, into the plant to help solve the problem. Mr. Meeka S. Lamb, the ACO, would not let Wolf see the contractor. Mr. Lamb explained what Wolf should work with his production scheduler, Mr. Ura Wrong, and Mr. Wrong would deal with the contractor. In this way, Mr. Lamb expected to keep the lines of communications with the contractor clear and direct. Do you think Mr. Lamb is correct? If not, what is the best approach?

[Acronyms introduced in this lesson, and their descriptions]

Chapter 7

ACO	Administrative Contracting Officer
CAOs	Contract Administration Organization(s)
CO	Contracting Officer
DCAS	Defense Contract Administrative Services
DCASMAs	Defense Contract Administrative Services Management Area:
DCASPROs	Defense Contract Administrative Services Plant Representative Office
DCASRs	Defense Contract Administrative Services Regions
GBL	Government Bill of Lading
PRO	Plant Representative Office
TCO	Termination Contracting Officer

CONTRACTING AUTHORITY

The purpose of this chapter is to provide a frame of reference within which one can understand the formation of a simple contract. The essential elements in contract formation are analyzed and related to the intentions of the parties who seek to enter the contractual relationship. This chapter also defines the Contracting Officer position. Responsibilities of contracting officers are divided and time-phased; the contract is awarded by the Procuring Contracting Officer (*PCO*); it is then assigned to an Administrative Contracting Office (*ACO*) for administration. In the event of a termination, it is assigned to a Termination Contracting Officer (*TCO*) to terminate. This chapter focuses on the authority of those positions.

1. The Contracting Officer (*CO*).

A Contracting Officer (*CO*) is any officer or civilian designated by the Air Force with authority to enter into and administer contracts for the Air Force. The CO is the only one vested with authority to bind the government contractually by entering into a contract or changing contract requirements. Each CO is warranted by the respective command, and the authorities delegated to him are generally not redelegable (to someone else). The Air Force has three types of contracting officers.

2. Authority of the PCO.

The contracting officer at the purchasing office which awards and executes a contract for supplies or services on behalf of the government, and, in the name of the United States of America, by sealed bids, by competitive proposals, or by coordinated or interdepartmental procurement, and, when authorized by FAR, administers such contracts.

3. Authority of the ACO.

The ACO is a duly appointed official who is assigned the responsibility for administration of government contracts. As a representative of the Government, the ACO may administer any Government contract, including all amendments. The scope of this authority is limited by the appointing official. The authority of the ACO is established and bounded by a number of factors. Included are:

a. *The contracting officer's warrant.* This provides a basic authority and establishes limits such as, dollar amounts.

b. *The FAR.* Part 42 lists specific functions which are automatically authorized for performance or that may be authorized at the discretion of the PCO.

c. *Letter of Contract Assignment.* When the PCO assigns a contract, certain unique authorities may be assigned or withheld.

d. *Statutory Law.* For the most part, these statutes are implemented by FAR and the DOD supplement thereto.

e. *Law of Agency.* The principal (Government) cannot deny the agent's authorized acts.

4. Authority of the TCO.

The contracting officer appointed to terminate contracts for convenience, and for default, when found in the best interest of the government, according to FAR; also, to

enter into settlement agreements by negotiation with the contractor.

5. Definition of a Contract.

Contract. A contract is a promise or set of promises for breach of which the law gives a remedy, or the performance of which the law in some way recognizes as a duty. Specifically, a contract is an agreement between two or more persons, based on a promise or mutual promises, which establishes an obligation that the law will enforce.

The social need for legally enforceable contracts is obvious. The efficient conduct of business in the absence of enforceable rights and obligations (contracts) would be impossible. Unenforceable promises are not enough to insure that businessmen will receive raw materials or finished goods, the transport needed for delivery of the product to the market place, and payment for goods sold and delivered at the time and place agreed upon.

Law of Contracts. American courts, using English jurisprudence and practices arising out of the common law, enforce the rights and duties arising from a valid contract. The law may provide a remedy for a breach of contract by awarding damages as compensation for the injury suffered as a result of the breach.

6. Contract Elements.

A contract must contain the following elements to be enforceable at law: an agreement between competent parties for a valid consideration to accomplish a lawful purpose with terms clearly set forth in the form required by law.

Agreement. Essential to any contract is an *agreement*, that may be defined as a demonstrated mutual assent between the parties. A so-called *meeting of the minds* must take place for a contract to come into being.

The *agreement*, or demonstrated *mutual assent* of the parties to a contract, must consist of an offer and an acceptance. The term *offer* means simply a proposal to enter into a contract. The person making the offer is termed an *offeror*, and the person to whom the offer is made is known as an *offeree*. The legal effect of an offer is to create a power of acceptance in the offeree. Therefore, for an offer to be valid, it must lead the offeree reasonably to believe that a power to create a contract is conferred; that is, to reasonably believe that, if the offer is accepted, a binding agreement will exist. No particular formality is required for an offer. It may be oral or written, express or implied, and it may be made by words, acts or forbearance, or by a combination thereof.

It is not every offer that may form the basis of a contract. Only those offers that meet the following requirements can ripen into an agreement upon due acceptance. The offer must be communicated to the offeree, and the offer must be definite and certain in its terms.

An offer becomes effective at the time that an offeree becomes aware that an offer has been made. If it is an oral offer it takes effect at the same time that the offeree hears the proposition. Written offers become effective when the offeree receives some form of written communication. The amount of time that the offer is to remain in effect may be limited by the offeror. The time span within which the offer must be accepted will commence on the day that the offeree receives the written offer and not on the day it is

mailed. If the letter is lost in the mail, or for some other reason the offeree does not receive the offer, the court may rule, depending upon the circumstances, that the offeree must be given an opportunity to consider the offer. If the offeror does not specifically set a time limitation as to when the offer must be accepted, the rule holds that it must be accepted within a reasonable length of time. Reasonableness would depend upon varying circumstances including the thing that is being offered.

Some examples of terminating an offer include:

a. an offeree may expressly reject the offer.

b. an offeree may make a counter-offer (as such, it acts to reject and terminate the original offer).

c. the offeror may withdraw (revoke) the offer prior to acceptance.

Competent Parties. An enforceable contract cannot be made by a party with no legal capacity to contract. The legal definitions of *competency* are beyond the scope of this chapter; however, some clear examples of incompetency are: intoxication or mental incompetency.

Valid Consideration. A promise not supported by consideration imposes no duty on the promisor. A fundamental concept in the formation of a contract is the element of bargain and exchange. Consideration is the price paid for a promise. Consideration exists when something of value must be given by the promise that the promisor bargained for as the agreed exchange for the promise.

Lawful Purpose. The courts will not recognize a contract dealing with an unlawful purpose. A contract is illegal if its formation or performance is criminal, tortious, or contrary to public policy. As a general rule, the law will not aid either party to such an unlawful agreement.

Terms Clearly Stated. It is essential to the enforceability of a contract that its terms be sufficiently clear to permit interpretation by the courts. The courts will apply various rules of construction to interpret the meaning to clarify any conflict or ambiguity.

Form Prescribed by Law. The legislatures, federal and state, have imposed certain additional requirements as to the form and manner of certain contracts. Typical of these would be contracts for the sale of real estate, which are generally required to be in writing. Also, a Statute of Frauds is in force in nearly all states, which requires that certain classes of contracts be in writing to be enforceable.

7. Definition of Agency.

Agency may be defined as *a relationship based upon an agreement that authorizes one person to act for another.* The law of agency assumes that there are three parties involved: the principal, the agent, and a third party. The principal authorizes the agent to act as an intermediary and to deal directly with the third party as if the agent were the principal. For example, contracting officers perform as representatives (agents) of the United States Government (the Principal) and, in so doing, they deal with contractors (third parties). The acts of the agent bind the principal to the third party and, also, give the principal rights against the third party.

Remember that an agent can only perform an act that the principal could lawfully do. The objective sought must be neither criminal nor contrary to public policy.

The primary difference between an agent and an employee is that the employee normally performs some kind of labor or service for the employer while the agent represents (can bind) the employer in dealings with third parties. An individual may wear two hats and perform as an employee and as an agent; this is an area that may cause many problems. An unwary contractor may, on occasion, assume the person being dealt with is an agent of a principal, when in reality the person is only an employee. Project engineers, technicians, inspectors, and other individuals working on projects for the Government may make statements that convey the impression that they have the authority to require the contractor to make certain changes. The individual making the statement may only be an employee, with no authority to make changes. An experienced contractor who does business with the Government knows that changes to his contract may only be made when authorized by the Government's agent, i.e., a contracting officer.

8. Reasons which may qualify a contractor for contract award.

Responsiveness.

To be considered for award, a bid must comply in all material respects with the invitation for bids and request for proposals. Such compliance enables all bidders or offerors to stand on an equal footing and, maintains the integrity of the sealed bidding and competitive proposal methods.

Responsible -- reasonableness of price.

The contracting officer shall determine that a prospective contractor is responsible and that the prices offered are reasonable before awarding the contract. The price analysis technique may be used as guidelines. In each case the determination shall be made in the light of all prevailing circumstances. Particular care must be taken in cases where only a single bid or offer is received.

Purchases shall be made from, and contracts shall be awarded to, responsible prospective contractors only. No purchase or award shall be made unless the contracting officer makes an affirmative determination of responsibility. In the absence of information clearly indicating that the prospective contractor is responsible, the contracting officer shall make a determination of non-responsibility. If the prospective contractor is a small business concern, the contracting officer shall comply with *Certificates of Competency* and *Determinations of Eligibility.*

The award of a contract to a supplier, based on lowest evaluated price alone, can be false economy if there is subsequent default, late deliveries, or other unsatisfactory performance resulting in additional contractual or administrative costs. While it is important that Government purchases be made at the lowest price, this does not require an award to a supplier solely because that supplier submits the lowest offer. A prospective contractor must affirmatively demonstrate its responsibility, including, when necessary, the responsibility of its proposed subcontractors.

To be determined responsible, a prospective contractor must --

(a) Have adequate financial resources to perform the contract, or the ability to obtain them;

(b) Be able to comply with the required or proposed delivery or performance schedule, taking into consideration all existing commercial and government business commitments;

(c) Have a satisfactory performance record;

(d) Have a satisfactory record of integrity and business ethics:

(e) Have the necessary organization, experience, accounting and operational controls, and technical skills, or the ability to obtain them (including, as appropriate, such elements as production control procedures, property control systems, and quality assurance measures applicable to materials to be produced or services to be performed by the prospective contractor and subcontractors); and

(f) Be otherwise qualified and eligible to receive an award under applicable laws and regulations.

9. Contract Administration.

Prior to the 1960's, the parent organization of the preaward function (Army, Navy, or Air Force) was responsible for the contract administration phase of each contract awarded. The inefficiencies of this system were highlighted by a special study (Project 60). In general, duplicative government Contract Administration Organizations (*CAO's*) (a combination of Army, Navy, and Air Force) at major DOD contractor facilities, each with its unique approach and procedures to the contract administration phase, increased the cost and created a situation that required the contractor to comply with many different agency peculiar requirements which were often in conflict with each other. To eliminate these inefficiencies, and present *one face to industry*, thereby avoiding conflicting agency requirements, the DOD reorganized in the early 1960's to the organization which exists today. Specifically, the Defense Supply Agency (now the Defense Logistics Agency) was created to perform acquisition functions common to each of the services. Of the many responsibilities of this agency, administration of DOD contracts was assigned to a newly created sub-agency called Defense Contract Administrative Services (*DCAS*). Since its creation, DCAS has been the principal government organization for contract administration. DCAS provides services through a network which establishes geographic areas of responsibility. The Continental United States and it's territories are divided into 9 separate areas of responsibility. These areas are called DCAS Regions (*DCASRs*). DCASRs currently are headquartered at Boston, New York, Philadelphia, Atlanta, Cleveland, Chicago, St. Louis, Dallas, and Los Angeles. Each region, in turn, is

geographically divided into management areas (*DCASMAs*) and DCAS Plant Representative Offices (*DCASPROs*). It is at this level that day-to-day contract administration occurs. DCASMAs have area wide responsibility for contract administration, unless the amount and complexity of government contracts at any one contractor location requires a dedicated team of contract administration specialists. When this dedicated work force is required, a Plant Representative Office (*PRO*) is established. When a PRO exists, it has total responsibility for administration of all DOD and NASA contracts performed at that location. Simply stated, if a PRO exists, the job is theirs; otherwise, the DCASMA has responsibility for all other contractors in their area.

10. Functions of the CAO.

DCASMAs, DCASPROs, AFPRO, NAVPRO, and ARPROs each have the following functions within their distinctive organizational structures. How much each function will contribute to contract administration will reflect the different conditions, different types of contracts and contract work, as well as parochial views.

Engineering. The majority of non-local purchase contracts is for items designed and manufactured only for DOD. Limited production, high technology and the rate of change to meet new military challenges all combine to create a relatively high level of engineering involvement in the contracts. CAO engineering personnel often work in close coordination with the requirements/buying activities.

The CAO engineering function is involved in proposed engineering changes (contractor or government), production difficulties relating to design, and surveillance of the contractor's engineering and configuration management, as well as progress surveillance of engineering tasks. This function often serves as the trained and knowledgeable eyes, ears, and hands for the distant buying office engineers, as well as engineering *translator* for other functions of the CAO.

Transportation. Supplies must be shipped to the proper destination, with the appropriate packaging as required. The transportation function monitors the contractor's efforts in these areas, provides technical assistance, and manages the issuance of Government Bills of Lading (*GBL*). GBLs are the documents used to arrange, and pay, for government provided shipment of supplies.

Security. Often government contracts require generation of, access to, or use of classified information and items. In such cases the contractor must have a security program acceptable to the government. The CAO therefore must monitor the program management, and provide technical assistance, as needed.

Property. Billions of dollars of property owned by the government is in the hands of contractors. Further, the contracts may state that specific property may be available as a condition of performance. The contractor must have an acceptable system for managing and accounting for such property and the CAO must monitor and evaluate the system. Further, the CAO provides technical assistance, and performs those approval tasks, required to maintain and account for government property.

Cost, Price and Financial Analysis. Throughout the acquisition process there is constant need to analyze, verify, negotiate, and approve contractor cost estimates. This function is performed both when the CAO has decision authority and, for the buying office (in conjunction with their specialists), when the buying office has retained

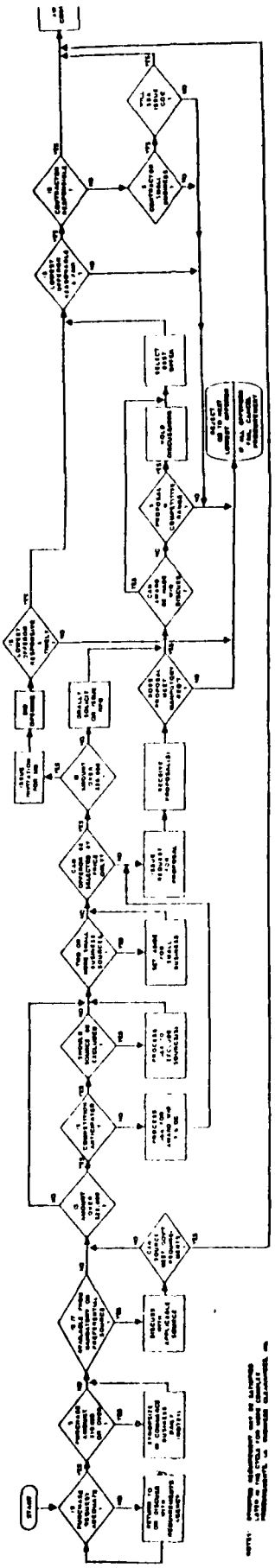
authority. Cost and price analysis normally is associated with the actions of awarding, as well as changing, the contract. In addition, analysis may be required in the final settlement of contracts. On one hand, it is necessary to determine if the contractor is strong enough to carry out a contract and on the other, to insure the contractor's financial management system assures only reasonable costs are expensed against government cost type contracts.

Production. Contractors must plan for production and control or manage the on-going production. The government/contractor relationship requires the government to monitor the management of these functions. Before the contract is awarded, the Government may assess whether the contractor has the manpower, machines, available capacity, and management to perform. During performance there is a need to insure delivery dates will be met, or, if difficulties arise, the solutions will correct discrepancies as soon as possible.

Quality. A level of quality is specified in every contract. Normally, it is too expensive to test everything. Therefore, included in the contract is a requirement that the contractor organize to insure the item is produced with the required level of quality control. The CAO must monitor the contractors *quality system* to insure it is adequate, and is properly implemented. Further, the CAO normally inspects the supplies, insures conformance to the contract, accepts title (government ownership) and authorizes payment.

Contractor. The *contracts* function includes several tasks; the most important is to act as the authorized on-site agent of the government. The ACO can legally bind the government as defined by delegation of authority from the buying office and in accordance with the FAR. By virtue of this role, the task of coordinating all the other functions becomes part of the contracting function. An additional task of the contracts function may be to review the contractor's contracting policies, procedures, and actions to ensure compliance with the government policies incorporated in the contract clauses.

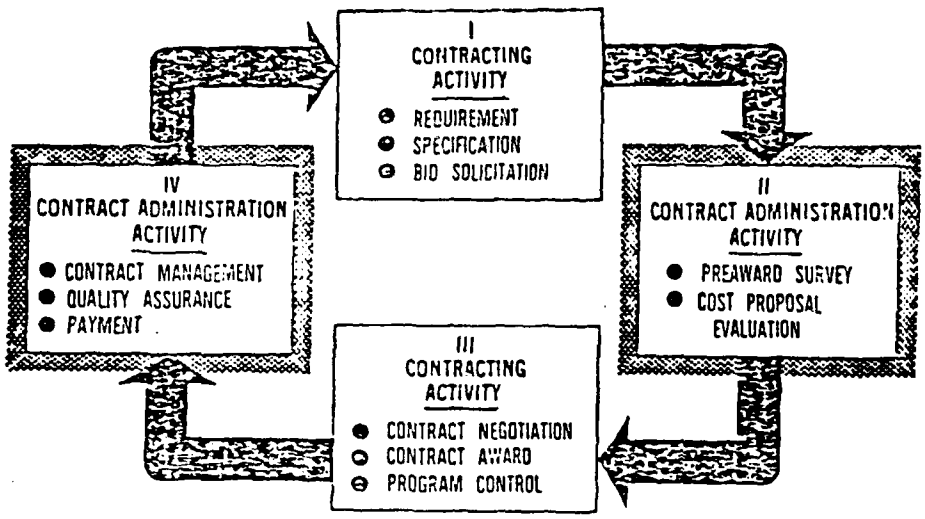
STEPS IN CONTRACT AWARD



FIVE ELEMENTS OF A CONTRACT

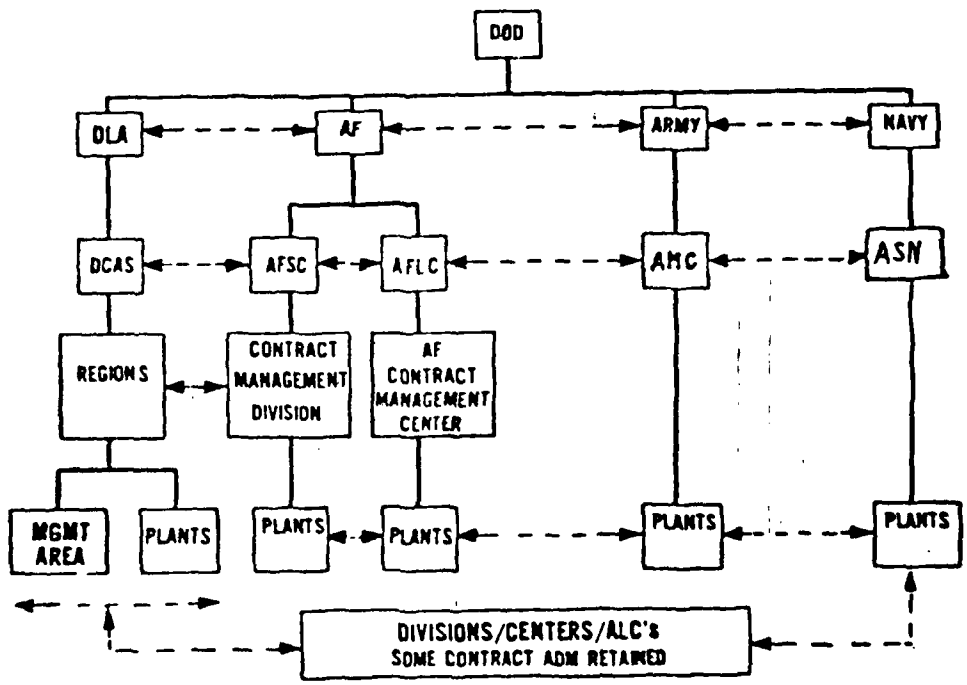
- AGREEMENT BETWEEN TWO PARTIES
- BOTH PARTIES COMPETENT AGENTS
- VALID CONSIDERATION
- LAWFUL PURPOSE
- CLEAR TERMS AND CONDITIONS

THE CONTRACTING CYCLE

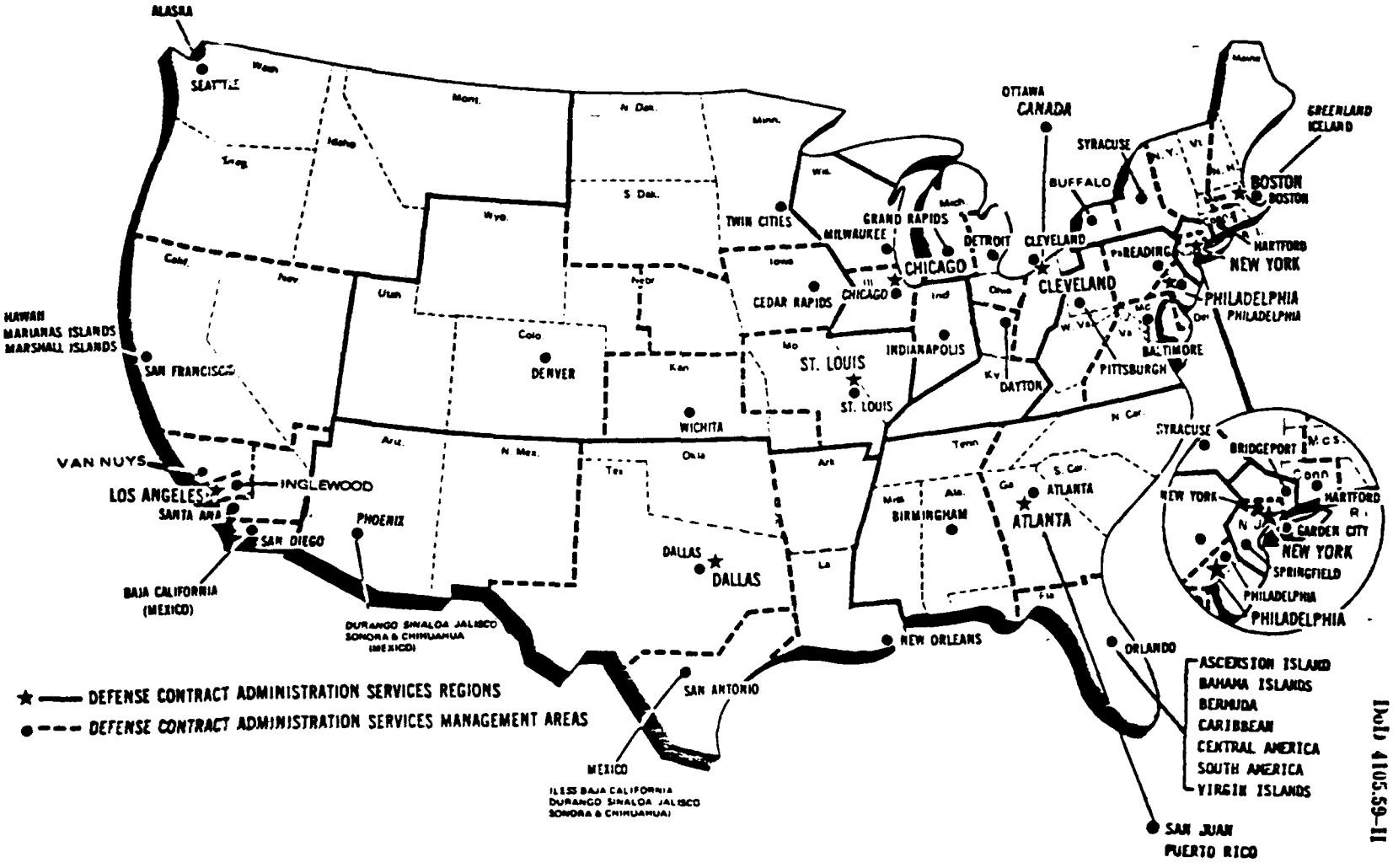


LIAISON

CURRENT POSTURE FOR CONTRACT MANAGEMENT

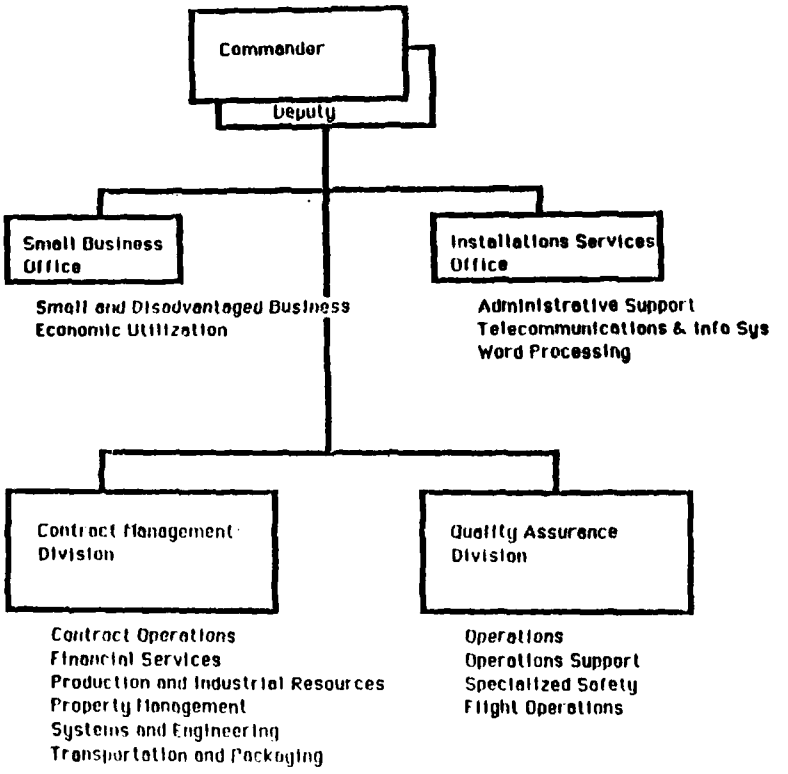


DCASR GEOGRAPHICAL BOUNDARIES AND COMPONENTS

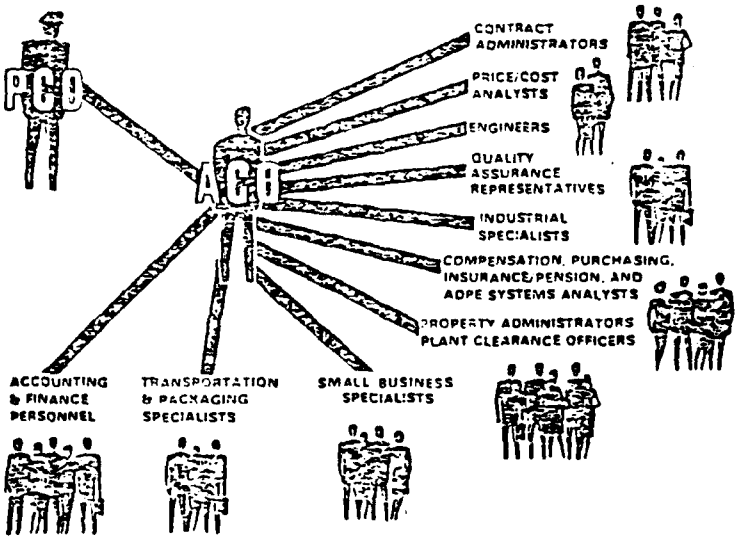


DoD 4105.59-H

TYPICAL DEFENSE CONTRACT ADMINISTRATION SERVICES MANAGEMENT AREA



CONTRACT MANAGEMENT IS A TEAM EFFORT



LESSON 8

LESSON TITLE: **Communication Exercise**

TIME: 1.5 hrs

LESSON OBJECTIVE: The objective of this lesson is for each student to know the communication process in management.

SAMPLES OF BEHAVIOR: Each student will be able to:

Describe the communication process in a management setting.

TOPIC INTRODUCTION: None.

METHOD OF INSTRUCTION: Communication Exercise

INSTRUCTIONAL MATERIALS: *Communication Exercise* handout

AUDIO-VISUAL AIDS: None

INSTRUCTIONAL EQUIPMENT: None

REFERENCES: None

REQUIRED STUDENT PREPARATION: None

DISCUSSION QUESTIONS:

Refer to exercise handouts and facilitator.

LESSON 9

LESSON TITLE: **Systems Engineering**

TIME: 2 hrs

LESSON OBJECTIVE: The objective of this lesson is for each student to know the systems engineering process as it is practiced in DOD Systems and the relationship between the systems engineering process and the design reviews required by MIL-STD-1521.

SAMPLES OF BEHAVIOR: Each student will be able to:

a. Describe the seven basic steps of the systems engineering process.

b. Describe the iterative nature of systems engineering.

c. Describe the general activities at the following:
   (1) System Requirements Review (*SRR*)
   (2) System Design Review (*SDR*)
   (3) Software Specification Review (*SSR*)
   (4) Preliminary Design Review (*PDR*)
   (5) Critical Design Review (*CDR*)
   (6) Test Readiness Review (*TRR*).

TOPIC INTRODUCTION:

The following lessons start Block 2 of instruction in SYS 100. Block 2 takes a look at the many different functional areas you have to be aware of, familiar with, and understand in managing your program. In some cases, some of the information presented in this block will be an expansion of material presented in Block 1. In all cases, however, grasping the information presented in Block 2 is necessary in managing your program.

Lesson 9 addresses the area of the Systems Engineering process as required in the Department of Defense development programs. As our weapon systems become more and more complex, we need a structure, or process, in which to select each technological alternative in an efficient and effective way. Systems Engineering provides the framework from which to make those decisions. The steps in this process are discussed, and, how they may be applied to a *typical* program. Finally, with the Systems Engineering process providing management insight into technical analysis effort, the design review process is discussed as a way for the government to get visibility into technical issues for problem identification and resolution.

METHOD OF INSTRUCTION: Lecture/Discussion

INSTRUCTIONAL MATERIALS:

a. Article, *The Systems Engineering Process*, by Mr Bill Dean, AFIT/LSY

b. *Systems Engineering* videotapes

c. Lesson viewgraphs

AUDIO-VISUAL AIDS: Chalkboard

INSTRUCTIONAL EQUIPMENT: Video monitor and 3/4" tape player

REFERENCES:

a. AFSCP 800-3, *A Guide for Program Management*, Chapter 8

b. MIL-STD-499A, *Engineering Management*

c. MIL-STD-1521B, *Technical Review and Audits for Systems, Equipment, and Computer Programs*

REQUIRED STUDENT PREPARATION:

a. Read article: *The System Engineering Process*

b. Scan lesson viewgraphs

DISCUSSION QUESTIONS:

1. As a part of the System Requirements Review, you are reviewing the draft System Specification for your new missile system, before signing it, to establish a Functional Baseline for the program. The ILS office becomes insistent about including requirements that the contractor has apparently left out. They want to include logistics-related constraints about accessibility, common support equipment, and levels of maintenance in the specification.

a. Is the contractor wrong to have omitted these constraints from a system specification? Why?

b. If this additional information is required, what is the normal way that you would get the contractor to include these requirements in the System Specification?

2. While participating in the System Design Review, one of your program office engineers identifies a potential problem with the contractor's design process. In reviewing the requirements being generated for the performance of the missile's guidance subsystem, the technology appears to be somewhat *dated*, if not antiquated. She has checked the backup analysis data used to select these requirements and found it to be very sketchy and inconclusive. She has also queried the contractor's lead designer for the guidance subsystem and been told that *This is the way we have designed all of our missile guidance subsystems.*

a. In your opinion, does there appear to be a real problem? On what do you base your answer?

b. Do you feel that the specification is adequate and ready for signing to establish the Allocated Baseline for the guidance subsystem?

c. What should you do to get the contractor to rectify the situation?

3. While attending a quarterly Program Review at the contractor's plant, shortly after the beginning of the Full Scale Development phase and before the Preliminary Design Review, Mr. D. Zeiner, a young engineer assigned to your program office, comes to you with a problem. He has been talking to the contractor's design group and has determined that they have not begun detail design work on the new missile you're developing.

a. As program manager, what should you do to correct this situation?

b. When should the contractor be required to accomplish the detail design work?

4. The software engineers supporting your program at the Critical Design Review are upset about the Contractor's detail software design documentation. It consists almost entirely of a detailed source code listing (written in the *Ada* higher-order language) with the backup analysis data substantiating the selected code design. The contractor contends that he has provided adequate design documentation.

a. Who is correct? On what do you base your answer?

b. What, if anything, will have to be done to correct the situation and to get the program back on schedule?

5. As the first set of operational units of the missile, constituting the Initial Operational Capability, are delivered to the field, your program office representative assigned to the Site Activation Task Force calls you with a problem. At least 30 percent of the support software, required to test and maintain the missile electronics, is not available, so it will be extremely difficult to maintain the equipment and will require many more maintenance manhours than originally projected.

a. What options does your program have to provide support for the operational units?

b. What should your program have done during development to assure that the support would be available?

Chapter 9

CDR	Critical Design Review
DBDD	Data Base Design Documents
FCA	Functional Configuration Audit
FQR	Formal Qualification Review
IDD	Interface Design Documents
PCA	Physical Configuration Audit
PDR	Preliminary Design Review
SDDD	Software Detail Design Documents
SDR	System Design Review
SRR	System Requirements Review
SSR	Software Specification Review
TRR	Test Readiness Review

THE SYSTEMS ENGINEERING PROCESS

HISTORY

In the past, weapon systems were relatively simple to develop. We were concerned with designing the primary mission equipment (e.g., a missile, a radar, or an airplane) to fulfill a certain stated need. Maintenance of the various components could be accomplished using standardized tools such as screwdrivers, wrenches, pliers, voltmeters, oscilloscopes, and signal generators. There was usually a requirement for the development of a few new tools and pieces of support equipment to support the mission items, but that effort was not a significant part of the development effort. Maintenance personnel were readily available and highly skilled. The primary additional effort related to support involved the preparation of the technical manuals which provided instructions on how to diagnose and correct problems using these standard and special tools and equipment.

In the last twenty years, however, weapon systems have become increasingly complex, aided by increased use of microminiaturized electronic circuitry and computer software. Also, available manpower has a smaller percentage of the highly skilled, career maintenance personnel. Systems engineering has become increasingly important as a development tool because of its ability to assess the viability of utilizing various technological alternatives while minimizing the risks inherent in developing a complex system. But, most importantly, system engineering provides a tool by which we can assess the optimality of each alternative as a part of the COMPLETE SYSTEM rather than just assessing its role in the mission equipment.

DEFINITIONS

The term system has many connotations; it is used to describe everything from environmental processes to distributed management information networks. It generally denotes an aggregation of a number of different elements which are combined to achieve a specific goal. In DOD, the term is used in the context of a weapon system and is defined as:

> *A composite of subsystems, assemblies (or sets), skills, and techniques capable of performing and/or supporting an operational role. A COMPLETE SYSTEM includes related facilities, items, material, services, and personnel required for its operation [and support] to the degree that it can be considered a self-sufficient item in its intended operational (or non-operational) and/or support environment. (DOD-STD-480)*

The heart of the system is the primary mission equipment and the related software that actually provides the operational capability; the mission items have always been the most important concern in developing a new system. Of equal importance for new systems, however, are the elements of support equipment and support software required to keep the system in operating condition. Because of the highly specialized designs of most new systems, a much larger percentage of the maintenance activity

requires the use of specialized tools, testers, and software developed specifically for this system. The system also includes the people; their professional specialties, and the level of their skills in those specialties, must be considered in identifying the various alternatives and in making the design decisions. The system includes the facilities ranging from production lines to electronics shops that will be needed to operate and maintain the system.

For purposes of system design, the system is usually divided into major subsystems and components in order to ease and to focus the management of the design effort. These elements are usually called configuration items (*CIs*), defined as:

> *An aggregation of hardware/software, or any of its discrete portions, which satisfies an end use function and is designated by the Government for configuration management. CIs may vary widely in complexity, size, and type, from an aircraft, electronic, or ship system to a test meter or round of ammunition. (DOD-STD-480)*

System engineering, as it is used in the DOD context, can then be defined in relation to all of these system elements as:

> *The application of scientific and engineering efforts to (a) transform an operational need into a description of system performance parameters and a system configuration through the use the an iterative process of definition, synthesis, analysis, design, test, and evaluation; (b) integrate related technical parameters and ensure compatibility of all physical, functional, and program interfaces in a manner that optimizes the total system definition and design; and, (c) integrate reliability, maintainability, safety, survivability, and human and other such factors into the total engineering effort to meet cost, schedule, and technical performance objectives (MIL-STD-499). System engineering is both a technical process and a set of management practices which must be applied throughout the system life cycle.*

THE SYSTEMS ENGINEERING PROCESS

System engineering has established a rigorous technical analysis process to be used to define all the interrelated constraints for all the elements of the system, be they people, logistics, or operational constraints. By defining all the system performance requirements or design constraints in our contractual technical baselines, the contractor must address all those constraints as a part of the systems engineering analyses and decisions. The resultant output design will be comprised of various system elements which have been optimized to work best together. It is likely that no one particular element will be the absolute best design for that particular function, but it is the best compromise design considering all of the various system factors.

System engineering also provides management insight into the status and the acceptability of the technical analysis effort. Through a series of design reviews, and through the configuration management audit activities, the government periodically assesses the status of the development effort. Through this review process, system engineering assures that the various specialty engineering groups are kept informed of each others' activities and of the adequacy of their efforts to date. MIL-STD-499

provides the requirements for (systems) engineering management that we can levy on the contractors. The contractors are the ones who do the systems engineering and who develop the system design.

Steps in the Process

MIL-STD-499 identifies numerous activities and considerations that should be included in the systems engineering process. These can be separated into seven basic systems engineering steps which comprise the process.

-- The first step requires that the designers review the complete set of requirements for the particular function they are trying to design.

-- With those requirements in mind, the second step requires them to identify the next two levels of functions that are necessary to achieve all the requirements for this function.

-- Having selected all of the functions, the third step requires that they identify all of the alternatives available to accomplish each function.

-- The fourth step requires them to prepare a requirements sheet for each alternative with a comprehensive list of requirements and constraints related to that alternative.

-- In the fifth step, they compare the advantages and disadvantages of the alternatives, based on these requirements and constraints.

-- In the sixth step, they select the alternative that seems to be the optimum compromise, based on the total system constraints, for this particular item.

-- In the seventh step, the contractor places the requirements sheet for the optimum alternative under internal control.

Iterating the Steps

Those seven steps comprise the heart of the systems engineering technical analysis process. But that isn't the complete process, because systems engineering is iterative; the seven steps are repeated over and over. Thus, the requirements that were placed under control in the seventh step of the current iteration are the ones considered in step one of the next iteration. The process is not unlike eating a hamburger. It's not advisable to try to eat it all in one gulp. If you try, you could choke on it. The same principle holds true for systems engineering. If the contractor's engineers try to address all of the thousands of detailed functional elements at all levels for the system and make decisions on all those elements at once, they'll be overwhelmed. The contractor has to divide the system into more manageable pieces and, like the burger, attack it a piece at a time.

The early stages of the systems design process involves the functional decomposition of the system. Using this concept of manageable sized pieces, the first iteration will address the two highest levels of functions. The contractor will use the seven steps to select the best alternative for each function at these two levels and will place the related requirements under internal control. Assuming that there were twelve functions analyzed in the first iteration, then the contractor, for the next iteration, will conduct twelve separate design analyses. The seven steps will be used again to decompose and analyze subfunctions for each of the twelve alternatives and to make decisions about the optimum alternative approach for each subfunction. Each of these twelve alternatives

represents a manageable-sized piece for the purposes of systems engineering. Assuming that there were ten functions for each alternative in this second iteration, then the third iteration would involve 120 separate design analyses, representing 120 manageable-sized pieces. The iterations will continue until optimum alternatives have been selected for all of the functional elements.

In the later stages of the systems design process, the contractor will also use the seven steps of the technical analysis process to iteratively analyze and optimize the detail design for each function already selected. The direction of their analysis has changed, however, in order to accomplish the detail design work. The engineers will start with the lowest-level functions and work up through the levels of CI functions. A requirements sheet was placed under contractor control for each optimum functional alternative selected during the functional decomposition and analysis of the system. The detail design alternatives for the function will be selected and analyzed based on those requirements. In this case, each detail design alternative has certain specific capabilities, as characterized by its vendor. Those capabilities will be compared and analyzed based on the requirement sheet parameters. Performance in specific areas will be analyzed and compared to determine which of the candidate design alternatives seems to be the best. Once the optimum alternative for that design element has been identified, the contractor will take control of that detail design using a drawing, a digital storage medium, or other formally released and controlled documentation. Having completed this iteration, the contractor will proceed to the next higher function. These same technical analysis steps will be used to determine the optimum detail design for each system function. The contractor will continue upward until detail design decisions have been made for all functions of the CI and of the system.

So each detail design iteration is very similar to each functional decomposition iteration. With systems engineering, we have an orderly process that we follow. We don't choke ourselves by trying to address too many related elements at one time. Instead, we look at manageable-sized chunks of the design with each iteration.

DESIGN REVIEWS

As a part of the overall design process, the government periodically must review the contractor's work thus far to assess its adequacy. MIL-STD-1521 defines specific design reviews and configuration audits that must be completed as part of the systems design process. Among other functions accomplished at these events, the government will review the specification content before establishing a baseline or will review the design's ability to fulfill the baseline requirements. We use the design reviews to identify the problems as early as we can. If we help the contractor's engineers to detect areas where the requirements or the design need to be revised, they use less time and money correcting the problems at this time than they would if they had to return later to accomplish the redesign, build new test articles, and reaccomplish some or all of the testing.

System Requirements Review (*SRR*)

The SRR is held to review the adequacy of the system requirements as defined by the draft system (or top item) specification. After the engineers have completed two or more iterations of the process and have identified requirements related to four or more levels of functions, sufficient requirements should have been adequately analyzed and selected to allow the finalization of the system specification. Before we accept the contents of the specification and establish the functional baseline, we need to make sure that the government technical, logistics, and using activities completely review the contents. MIL-STD-1521 requires that the government review the contents of the system specification at an SRR. We must make sure that all necessary system requirements and constraints are adequately defined. In addition to system performance, we must be sure that the specification includes constraints related to logistics support, personnel, interfaces, and existing off-the-shelf government equipment. We also review the adequacy of the verification provisions that will be used to determine that the system requirements have been met. During the review, we need to check the analysis data the contractor has used in arriving at these specification requirements. The review of the analysis data can help us determine the superiority of the requirements (and of a particular alternative) selected over those for any other alternative.

MIL-STD-1521 recommends that the SRR be conducted around the end of the concept exploration phase or the beginning of the demonstration/validation phase of the program. A reasonably complete definition of the systems requirements should have been accomplished by this time. The government should have made decisions related to the system performance and should be ready to sign the system specification to establish the functional baseline. This action puts the system requirements under government contractual control; if either the contractor or the program office wants to change the requirements after this time, an engineering change proposal will be required.

System Design Review (*SDR*)

An SDR is held for each hardware CI to review the requirements in the draft hardware development (performance requirements) specification before we establish an allocated baseline for that CI. As a result of the completion of one or two additional iterations, the engineers should have analyzed and defined more functional requirements for many additional sub-functions. These should be sufficient to allow finalization of the development specifications for your highest-level CIs. (On the other hand, more iterations will be required before SDRs can be held for the lower-level CIs.) Since most of the development and testing effort is accomplished at the CI level, we need to make sure that the requirements and the tests called out in the CI's development specification are adequate and complete. During the review, we need to check the analysis data the contractor has used to decide on the specification requirements. The review of the analysis data can help us determine the superiority of the requirements (and of a particular alternative) selected over those for any other alternative.

MIL-STD-1521 recommends that we establish an allocated baseline for each CI, after completion of its SDR, near the end of the demonstration/validation phase or at the beginning of the full scale development phase of the program. The baseline establishes a contractual agreement between the government and the contractor about the required CI performance and about the tests that will be conducted to verify that

performance. The baseline provides the technical basis for the full scale development effort as the contractor finalizes the optimum functional design of the CI, selects the optimum detail design for each functional element, and finally tests the detail design to be sure the CI performs to the baseline requirements. Any changes that the government or the contractor wants to make to these requirements will involve submittal of an engineering change proposal. The number of such changes can be minimized if we have done our homework well before establishing the baseline.

Software Specification Review (*SSR*)

The SSR, as required by DOD-STD-2167, is held for each software CI to review the requirements in the draft software (performance) requirements specification. We must review the requirements in the software requirements specification (and in the interface requirements specification, if used) before we establish the allocated baseline for the software CI. The activities and documentation at the SSR are very similar to those at the SDR. We need to make sure that we agree with the requirements and tests in the software specification. We should review the backup analysis data to make sure that we agree with the decisions about the alternatives and requirements the contractor made as reflected in the contents of the specification. As a result of the SSR, we will sign the software requirements specification and establish the allocated baseline for the software CI. This would normally happen late in the demonstration/validation phase or at the beginning of the full scale development phase.

Preliminary Design Review (*PDR*)

The systems engineers will continue this iterative process of functional decomposition, working their way down through the system functions, until they have identified all functions and adequately characterized them in the requirements documentation. At this point, MIL-STD-1521 requires that we conduct a PDR for each CI before the contractor begins the detail design process. The PDR is held for each CI to review the functional design analyses completed (and the design functions and related requirements/constraints selected) by the contractor. It is a check to verify that all of the CI's allocated baseline requirements, including interfaces, have been addressed and that they can most likely be met or exceeded by the contractor's proposed functional design. The PDR would normally be accomplished during the first few months of the full-scale development phase.

We need to have a reasonable degree of confidence, based on that functional design, that the contractor will be able to achieve the performance required in the allocated baseline for that CI. The contractor has made many decisions about optimum functions and their related performance parameters. That functional design is considered to be the best for our needs. We should look at the contractor analysis data for the various alternatives where critical performance elements are involved or where we have questions about the functional alternatives selected. If we find areas where the contractor's design seems to be weak, or where it seems to be unable to meet our requirements, we will identify them to the contractor. We'll ask the contractor to accomplish additional design work in that area or to provide us with additional data about the area.

Critical Design Review (*CDR*)

The CDR is held for each CI to review the details of the specific design (generated by the contractor) before fabrication of test hardware or detailed coding of test software is begun. Systems engineering has to consider both the analysis and selection of the optimum detail design alternative based on the requirements sheet for this function; however, it must also consider the additional constraints arising from previously-selected, lower-level detail design elements. The CDR is a check to assure that the detail design addresses all allocated baseline requirements and interfaces and can be reasonably expected to meet those baseline requirements for the CI. It would normally be accomplished a few months after the PDR.

The detail design for the hardware is contained in drawings, schematic diagrams, and related documents. For software, DOD-STD-2167 requires that Software Detail Design Documents (*SDDD*), Data Base Design Documents (*DBDD*), and Interface Design Documents (*IDD*), plus related documents, be available for our review. MIL-STD-1521 is very specific in requiring these software design documents rather than the line-by-line listing of the code (e.g. in FORTRAN, ATLAS, or Ada).

At the CDR, we're concerned with reviewing the detail design on the hardware drawings before the contractor manufactures actual test items. For critical performance elements, and for apparently weak areas of the design, we should look at the analysis data the contractor used in arriving at the design decisions. If there are discrepancies, we want to work them out while the design is still on paper. We'll require further design work in that area, or at least more information, to revise or substantiate the detail design in that problem area. If a discrepant design is translated into hardware or software and testing begins, it will eventually cause testing delays and additional expense to redesign it and remanufacture it. So we want to work out the problems as early as we can.

Test Readiness Review (*TRR*)

Using the software design documents reviewed at the CDR, the contractor will write the software code. Once the code for a logical unit or component of the software has been written, informal tests will be conducted on it to simulate the actual conditions of operation and to find out whether it works. However, DOD-STD-2167 requires some special emphasis on the coding and testing of the software CIs.

The Test Readiness Review (*TRR*) is applicable only to software as it is currently described in MIL-STD-1521. It is to be held to review the results of the informal testing of the units and components of the software CI and to review the preparations for the CI-level testing. If the initial testing revealed major problems that have not been corrected, or if the test cases and test procedures for the CI testing do not appear to be exhaustive enough to fully exercise the software, then the software CI testing will be delayed to correct these faults.

Functional Configuration Audit (*FCA*)

The contractor will conduct the qualification testing for each CI based on the contents of the test (quality assurance) section of the development or requirements specification for that CI. That's why the contents of that test section of the specification

must be reviewed so carefully before the specification is baselined. Detailed test procedures will be written and submitted to the government for approval. We will check very carefully to be sure that the test procedures reflect all the required tests. We need to be sure that the necessary instrumentation is identified so we'll get the data that we need to verify the performance. After the contractor has obtained our approval, the testing will be conducted and the test data acquired. During the testing, if some instrumentation is unavailable to support the test, a change to the procedures may be requested by the contractor, but it has to be approved by our on-site test representative. After the testing is completed, the contractor will compile and analyze the test data, prepare formal test reports, and submit the test results to the government.

The Functional Configuration Audit (*FCA*) is held for each CI to review the results of the contractor's qualification tests and to verify that the contractor's detail design has successfully met or exceeded the performance specified in the allocated baseline for that CI. We verify that the contractor followed the test procedures, that all the testing was completed satisfactorily, and that all the required data was gathered. Government engineers, assisted by using command and support personnel, will review all the test results to verify that the contractor's design meets our requirements. If we find problems in the actual performance capabilities, we cite the discrepancy and agree with the contractor on further obligations under the existing contract to redesign the deficient part or to conduct further testing. The FCA would normally be accomplished near the end of the full scale development phase.

Formal Qualification Review (*FQR*)

The FQR may be held in lieu of, or in addition to, the FCA. It is held to verify the successful completion of all system- level (multiple CI) qualification testing. The FQR will be used when the contractor is unable to verify all elements of the system performance at the CI level. In those cases, system-level testing will be required, and the FQR is held to verify that the design meets the functional baseline requirements. The documentation to be checked and the tasks to be accomplished are nearly identical to those at the FCA. The difference is that we are verifying the system-level requirements (i.e. the functional baseline). If we find problems in the actual performance capabilities, we cite the discrepancy and agree with the contractor on further obligations under the existing contract to redesign the deficient part or to conduct further testing. The FQR may be accomplished late in the full scale development phase or early in the production phase. Wherever possible, it should be completed before the PCAs for the top-level CIs of the system are held. In cases where all of the system-level requirements have been verified during the testing and the resulting FCAs for the individual CIs, it is not necessary to hold an FQR.

Physical Configuration Audit (*PCA*)

The PCA is held to verify that the design documentation (drawings, parts lists, software listings, etc.) accurately defined the qualified production configuration as described in the product specification. If so, we will take control of that design by signing the specification and establishing a product baseline. For hardware, we will check a sample of the parts in the production unit against the drawings referenced in the product specification to be sure that they are the correct design. For software, we check the

listing in the specification against a listing taken from the disk or tape that the contractor plans to deliver. The PCA is normally accomplished early in the production phase when the first production item is ready for delivery. An FCA must be completed for the CI prior to, or concurrent with, the PCA for that CI.

In addition to verifying accurate documentation of the production design, we must also make sure that the engineering release system provides the contractor with adequate control of the documentation. The contractor uses the engineering release system to control the manufacturing documentation and to control and record the configuration of the items being delivered and used out in the operational arena. We need to make sure that only the most current, approved documentation is being used, in order that only the most current, approved design is being delivered. The primary idea for the PCA is to make sure that we have an accurate description of the detail design and then establish a product baseline to take control of that detail design. From that point on, the government controls any changes to the detail design because of the possible impact on units and support elements out in the field. We have to have control over the design so that we don't lose control of our logistics support system.

INTERRELATIONSHIP WITH THE WORK BREAKDOWN STRUCTURE

In accomplishing the functional decomposition of the system, the system functions can be depicted by a hierarchical chart such as a block diagram or an indentured listing. This hierarchy is used to establish the Work Breakdown Structure (*WBS*) elements for the system. The WBS is a product-oriented family tree composed of the subelements of the system hardware and software plus the service and data activities that are an inherent part of the project engineering efforts during the development of a system. The WBS will be used for allocating budgets for manhours and dollars to be expended on the project. Most commonly, the cost and schedule information is budgeted and tracked against the WBS elements in the services area, not in the system subelement area, and the totals identified only against the top-level item or system.

SUMMARY

System engineering is both a technical process and a set of management practices which must be applied throughout the system life cycle. System engineering has established a rigorous technical analysis process to be used to define all the interrelated constraints for all the elements of the system, be they people, logistics, or operational constraints. By defining all the system performance requirements or design constraints in our contractual technical baselines, the contractor has to address all of those constraints as a part of the systems engineering analyses and decisions. The resultant output design will be comprised of various system elements which have been optimized to work best together. It is likely that no one particular element will be the absolute best design for that particular function, but it is the best compromise design considering all of the various system factors. But the key is that the contractor will have completed the design of a COMPLETE SYSTEM.

SYSTEMS ENGINEERING
(MIL-STD-499A)

ADDRESS ALL SYSTEM ELEMENTS
- -MISSION EQUIPMENT AND SOFTWARE
- -SUPPORT EQUIPMENT AND SOFTWARE
- -FACILITIES
- -PRODUCIBILITY
- -MAINTENANCE AND SUPPLY
- -PERSONNEL AND TRAINING

INTEGRATED DESIGN EFFORT
- -DEFINE ALL INTERRELATED CONSTRAINTS
- -DESIGN CONSIDERS ALL CONSTRAINTS
- -OPTIMUM DESIGN ELEMENTS WORK TOGETHER

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1

SYSTEM ENGINEERING STEPS

1. REVIEW REQTS FOR FUNCTION
2. IDENTIFY NEXT TWO LEVELS
3. LIST ALTERNATIVES FOR EACH
4. LIST ALL RQTS FOR EACH
5. COMPARE ALTERNATIVES
6. SELECT BEST ALTERNATIVE
7. PUT RQTS UNDER CONTROL

REPEAT

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SYSTEMS ENGINEERING IS ITERATIVE

ITERATIVE=PERFORMED AGAIN AND AGAIN

START AT HIGHEST LEVEL
- -IDENTIFY OPTIMUM FUNCTIONAL SOLUTIONS
- -CONTROL RELATED REQ'TS/CONSTRAINTS

REPEAT FOR NEXT LOWER LEVEL
- -IDENTIFY OPTIMUM FUNCTIONAL SOLUTIONS
- -CONTROL RELATED REQ'TS/CONSTRAINTS

CHANGE HIGHER LEVEL REQ'TS?
- -NEWER, MORE DETAILED INFORMATION

CONTINUE WITH ITERATIONS

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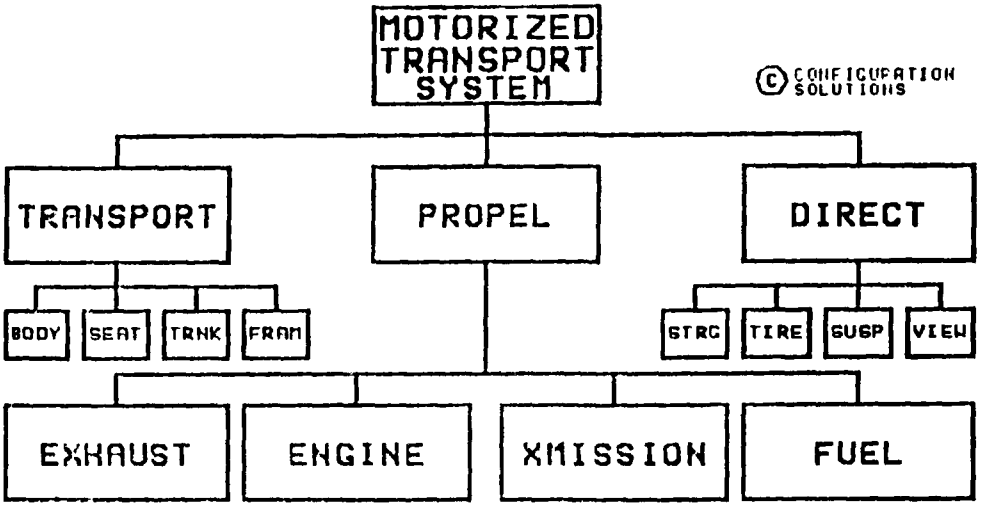
MOTORIZED TRANSPORTATION SYSTEM

STATEMENT OF OPERATIONAL NEED

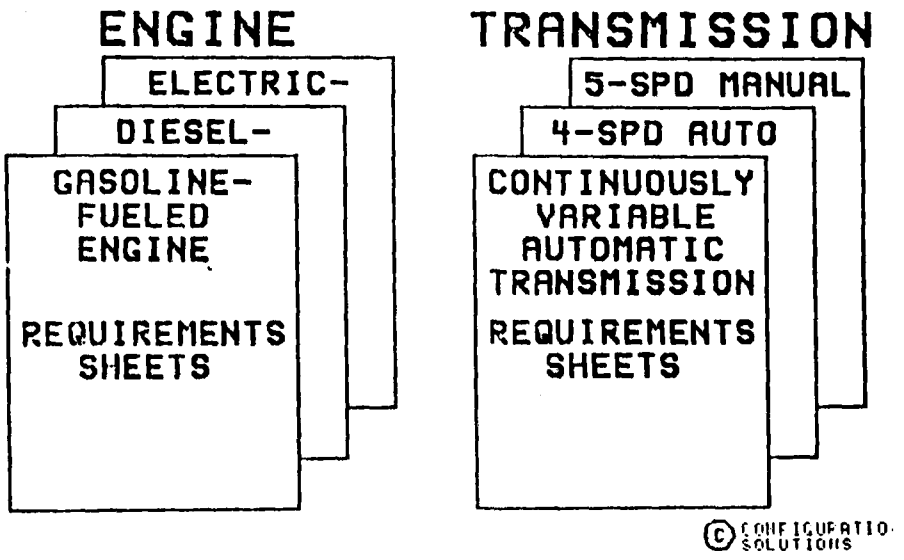
- -CARRY FOUR SIX-FOOT PEOPLE IN COMFORT
- -AT LEAST TWENTY CUBIC FEET OF TRUNK SPACE
- -INTERIOR NOISE LESS THAN 62 DB AT 60 MPH
- -INTERIOR AIR-CONDITIONED FOR COMFORT
- -FUEL ECONOMY OVER 35 HWY/25 CITY
- -HIGH RELIABILITY/LONG SERVICE INTERVALS
- -EASY ACCESS TO ELECTRONIC/MECHANICAL PARTS
- -AUTOMATIC FAILURE DIAGNOSIS/IDENTIFICATION

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IDENTIFY FIRST TWO LEVELS

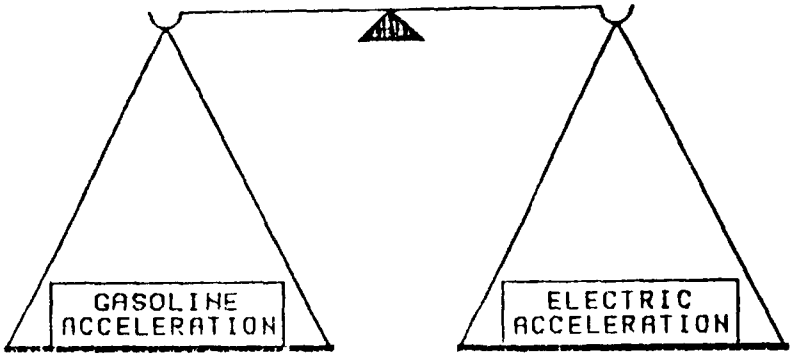


ALTERNATIVES/REQUIREMENTS



COMPARE ALTERNATIVES

ADDRESS EACH ATTRIBUTE/CONSTRAINT



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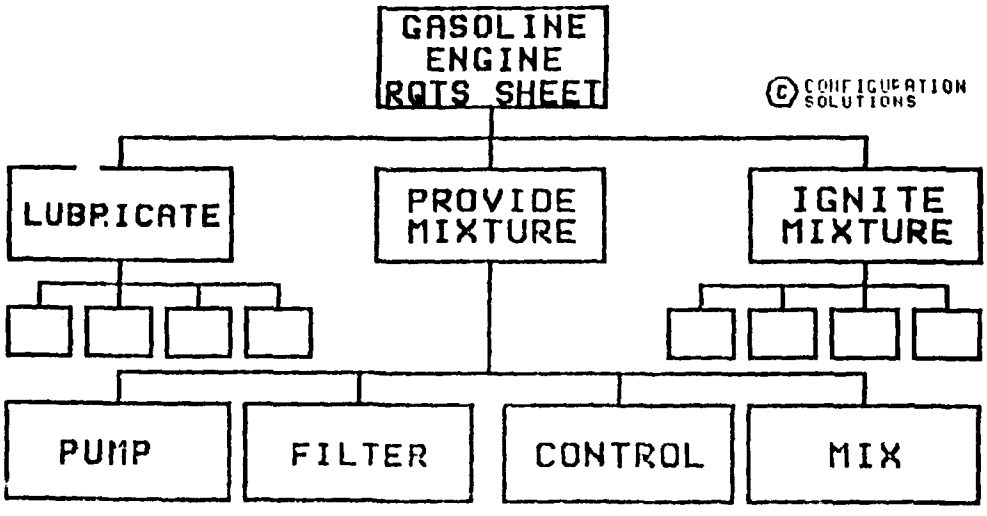
SELECT OPTIMUM ALTERNATIVE

	ELEC	GAS	DIES
COMPLEXITY	1	3	2
FUEL ECONOMY	1	3	2
ACCELERATION	2	1	3
STARTING EASE	1	2	3
RELIABILITY	2	2	2
TOP SPEED	3	1	2
RETRAINING	3	1	2
RISK	2	2	2
LIFE CYCLE COST	3	2	1
	18	17	19

CONTROL REQUIREMENTS SHEETS

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IDENTIFY NEXT TWO LEVELS



SYSTEM REQUIREMENTS REVIEW (SRR)

REVIEW SYSTEM SPECIFICATION

- -ALL NECESSARY SYSTEM REQ'TS/CONSTRAINTS
- -SUPPORT AND PERSONNEL CONSTRAINTS
- -INTRA- AND INTER-SYSTEM INTERFACES
- -SYSTEM TESTS TO VERIFY REQUIREMENTS
- -"TO BE DETERMINED" (TBD) REQUIREMENTS

REVIEW ANALYSIS DATA

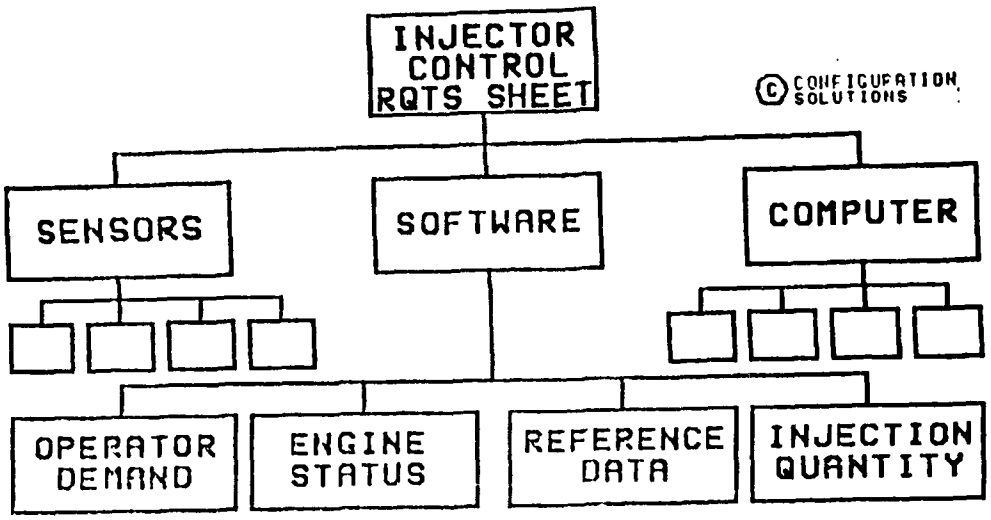
- -OPTIMUM PERFORMANCE CAPABILITIES
- -TECHNICAL/COST/SCHEDULE RISKS MINIMIZED
- -LIFE CYCLE COST (LCC) MINIMIZED

ESTABLISH FUNCTIONAL BASELINE

- -REQUIREMENTS SUBJECT TO GOV'T CONTROL
- -SYSTEM SPEC CHANGES REQUIRE ECP

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IDENTIFY NEXT TWO LEVELS



SYSTEM DESIGN REVIEW (SDR)

REVIEW CI DEVELOPMENT SPEC

- -APPLICABLE SYSTEM-LEVEL REQUIREMENTS
- -NECESSARY ADDITIONAL ITEM REQUIREMENTS
- -SUPPORT AND PERSONNEL CONSTRAINTS
- -COMPREHENSIVE TESTS TO VERIFY ALL REQ'TS

REVIEW ANALYSIS DATA

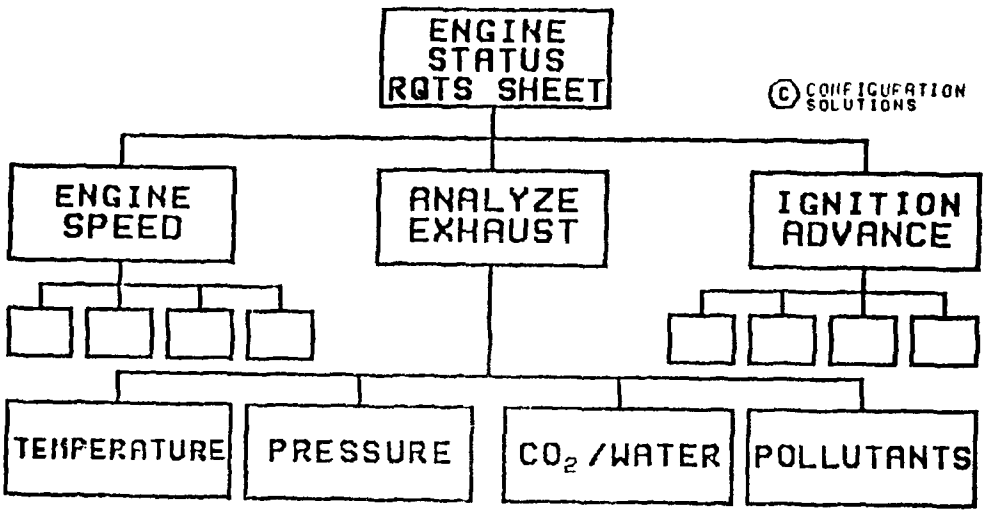
- -OPTIMUM PERFORMANCE CAPABILITIES
- -LCC AND RISKS MINIMIZED

ESTABLISH ALLOCATED BASELINE

- -REQUIREMENTS SUBJECT TO GOV'T CONTROL
- -DEVELOPMENT SPEC CHANGES REQUIRE ECP

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IDENTIFY NEXT TWO LEVELS



SOFTWARE SPEC REVIEW (SSR)

REVIEW CI DEVELOPMENT SPEC

- -APPLICABLE SYSTEM-LEVEL REQUIREMENTS
- -NECESSARY ADDITIONAL ITEM REQUIREMENTS
- -FUNCTIONAL INPUT/PROCESSING/OUTPUT REQTS
- -COMPREHENSIVE TESTS TO VERIFY ALL REQ'TS

REVIEW ANALYSIS DATA

- -OPTIMUM PERFORMANCE CAPABILITIES
- -LCC AND RISKS MINIMIZED

ESTABLISH ALLOCATED BASELINE

- -REQUIREMENTS SUBJECT TO GOV'T CONTROL
- -DEVELOPMENT SPEC CHANGES REQUIRE ECP

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CONTINUE
FOR AS MANY
ITERATIONS
AS NEEDED

IDENTIFY ALL FUNCTIONS

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PRELIMINARY DESIGN REVIEW (PDR)

REVIEW FUNCTIONAL DESIGN
- -H/W FUNCTIONAL BLOCK DIAGRAMS/REQTS
- -S/W TOP LEVEL DESIGN DOCUMENT (STLDD)

COMPARE TO BASELINE REQ'TS
- -MEETS PERFORMANCE/INTERFACE REQ'TS
- -MEETS SUPPORT AND PERSONNEL CONSTRAINTS

REVIEW ANALYSIS DATA
- -LOCATE/ANALYZE WEAK AREAS
- -IDENTIFY LIFE CYCLE COST DRIVERS

PROBLEM AREA --> WRITEUP

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DETAIL DESIGN PROCESS

START WITH LOWEST-LEVEL FUNCTIONS

- -USE REQUIREMENTS SHEET FOR EACH FUNCTION
- -IDENTIFY DETAIL DESIGN ALTERNATIVES
- -ANALYZE AND COMPARE DESIGN ALTERNATIVES
- -RECORD AND CONTROL BEST ALTERNATIVE

PROCEED TO NEXT HIGHER FUNCTION

- -REPEAT THE DETAIL DESIGN ANALYSIS

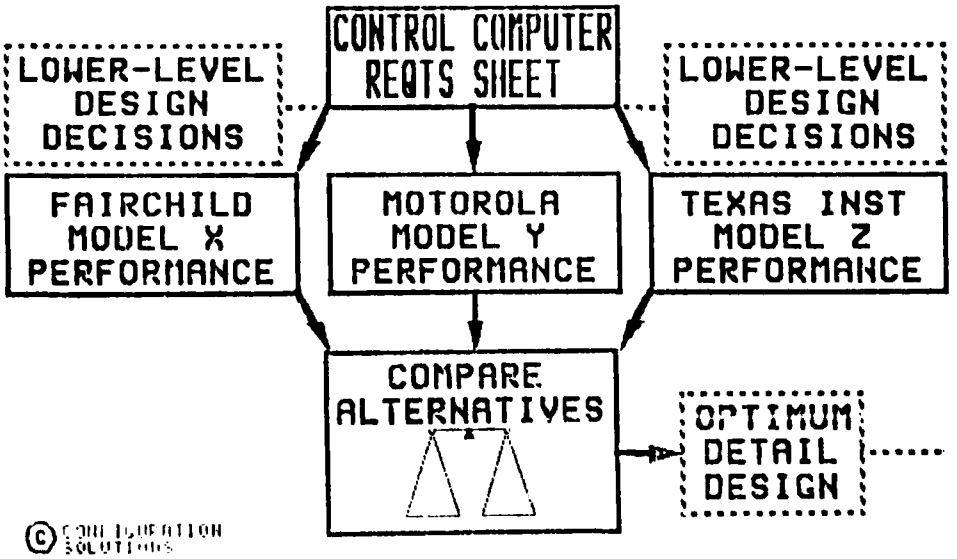
CONTINUE UP TO CI LEVEL

CONDUCT CRITICAL DESIGN REVIEW

- -FOR EACH CONFIGURATION ITEM

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DETAIL DESIGN PROCESS



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CRITICAL DESIGN REVIEW (CDR)

REVIEW DETAIL DESIGN

- -HARDWARE DETAIL DRAWINGS
- -ELECTRONIC CIRCUIT SCHEMATICS
- -SOFTWARE DETAIL DESIGN DOCUMENT (SDDD)
- -DATA BASE DESIGN DOCUMENT (DBDD)

COMPARE TO BASELINE REQ'TS

- -MEETS PERFORMANCE/INTERFACE REQ'TS
- -MEETS SUPPORT AND PERSONNEL CONSTRAINTS

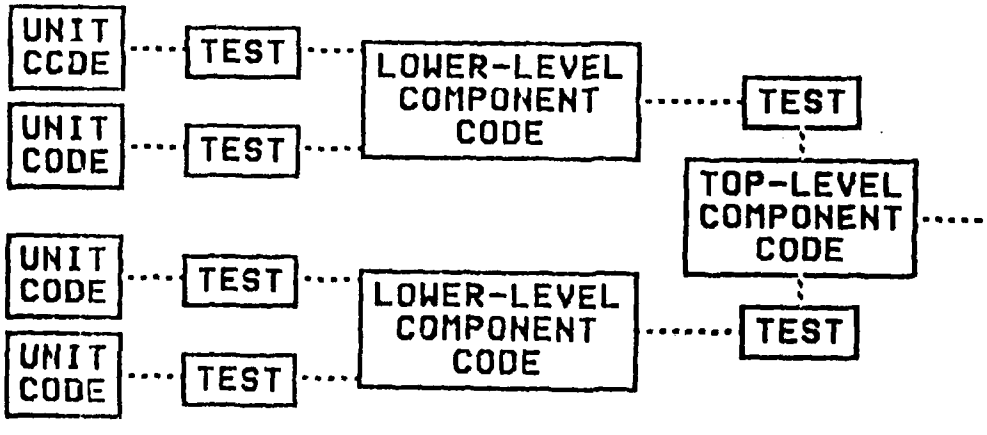
REVIEW ANALYSIS DATA

- -LOCATE AND ANALYZE WEAK DESIGN AREAS
- -CHECK ALTERNATES ON LCC COST DRIVERS

PROBLEM AREA --> WRITEUP

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WRITE/TEST SOFTWARE CODE



USE DESIGN DOCUMENTS FOR CODING

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TEST READINESS REVIEW (TRR)

REQUIRED FOR SOFTWARE ONLY

REVIEW PRELIMINARY TESTING

- -ITEM AND COMPONENT LEVEL
- -SATISFACTORY RESULTS VS. BASELINE
- -NECESSARY CODING CHANGES ACCOMPLISHED

REVIEW PLANNED CI TESTING

- -PROPOSED TEST CASES ARE ADEQUATE
- -TEST PROCEDURES ARE ADEQUATE

CONTRACTOR READY FOR CI TEST

- -APPROVE CSCI QUAL TEST PROCEDURES
- -ON-SITE REP CONTROLS CHANGES

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CONDUCT QUALIFICATION TESTING

ANALYZE CI TEST REQ'TS

- -FROM SECTION 4 OF CI DEVELOPMENT SPEC

PREPARE TEST PROCEDURES

- -DETAILED, STEP-BY-STEP PROCEDURES
- -TEST CONDITION DATA REQUIRED
- -SPECIFIC INSTRUMENTATION TO BE CONNECTED
- -DATA TO BE RECORDED DURING TESTING

OBTAIN GOVERNMENT APPROVAL

CONDUCT THE TEST PROGRAM

REPORT THE TEST RESULTS

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FUNCTIONAL CONFIGURATION AUDIT (FCA)

DOES CI MEET BASELINE REQ'TS?

- -TESTING FOLLOWED APPROVED PROCEDURES
- -ALL TESTING SUCCESSFULLY COMPLETED
- -DATA/REPORTS/ANALYSES VERIFIED
- -DATA VALID FOR FINAL CONFIGURATION

RECORD FINAL TEST ITEM CONFIG

FORMAL QUALIFICATION REVIEW (FQR)

DOES SYSTEM MEET BASELINE REQTS?
SAME BASIC PROCEDURES AS FCA

PROBLEM AREA --> WRITEUP

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PHYSICAL CONFIGURATION AUDIT (PCA)

PRODUCT SPEC DEFINES DESIGN

- -USE EARLY HARDWARE UNIT/SOFTWARE COPY
- -CHECK DELIVERABLE AGAINST SPEC DESIGN
  - •COPY LISTING AGAINST SPEC LISTING
  - •HARDWARE AGAINST SPEC REFERENCED DWGS

CHECK ENGRG RELEASE SYSTEM

- -ONLY CURRENT, APPROVED DOCUMENTS IN USE
- -OUTDATED DOCUMENTS/VERSIONS REMOVED

ESTABLISH PRODUCT BASELINE

- -SIGN/AUTHENTICATE PRODUCT SPEC

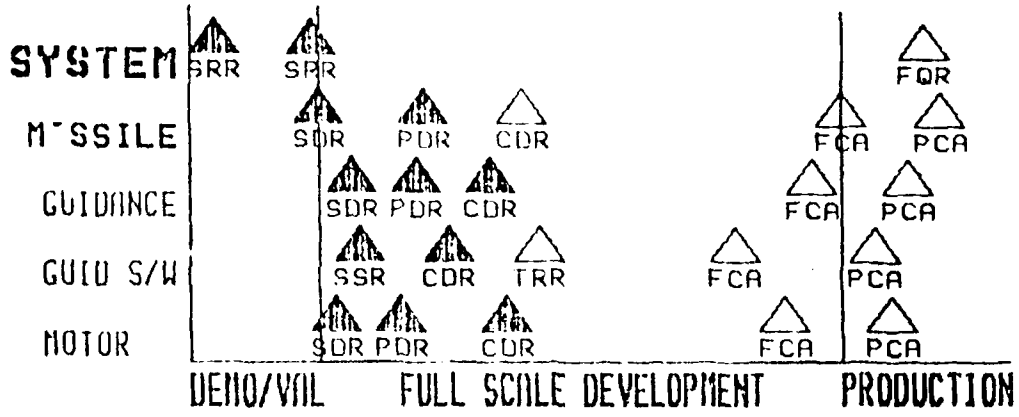
GOVT CONTROLS DETAIL DESIGN

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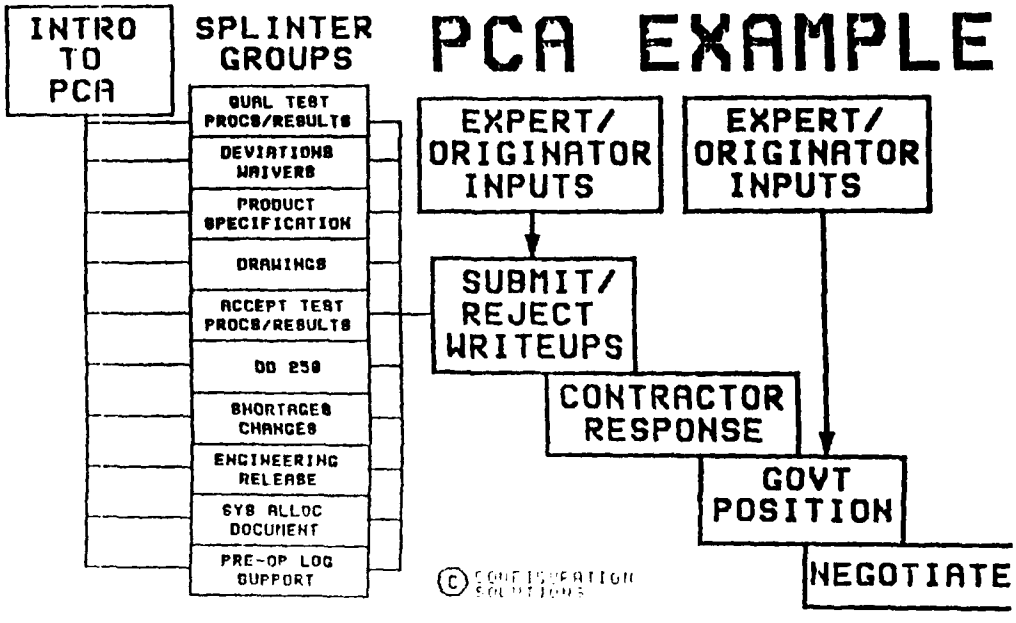
REVIEW/AUDIT PROCESS

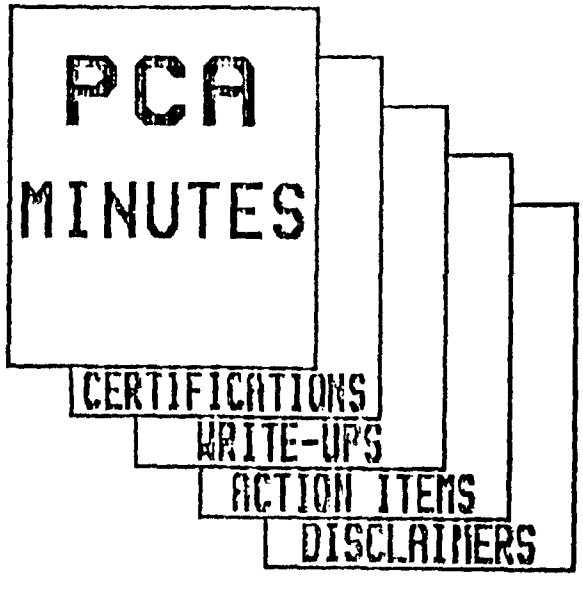
WRITE TASKS/1521 IN CONTRACT
PLAN SEQUENCE WITH CONTRACTOR
CONVENE/CONDUCT THE MEETING
DOCUMENT THE DESIGN STATUS
FOLLOW-UP AND CLOSE OUT

MISSILE SYSTEM REVIEW/AUDIT SCHEDULE



©


INTRO TO PCA
SPLINTER GROUPS
QUAL TEST PROCS/RESULTS
DEVIATIONS WAIVERS
PRODUCT SPECIFICATION
DRAWINGS
ACCEPT TEST PROCS/RESULTS
DD 250
SHORTAGES CHANGES
ENGINEERING RELEASE
SYS ALLOC DOCUMENT
PRE-OP LOG SUPPORT
PCA EXAMPLE
EXPERT/ ORIGINATOR INPUTS
EXPERT/ ORIGINATOR INPUTS
SUBMIT/ REJECT WRITEUPS
CONTRACTOR RESPONSE
GOVT POSITION
NEGOTIATE


PCA
MINUTES
CERTIFICATIONS
WRITE-UPS
ACTION ITEMS
DISCLAIMERS

LESSON 10

LESSON TITLE: **Integrated Logistics Support** (*ILS*)

TIME: **2 hrs**

LESSON OBJECTIVE: The objective of this lesson is for each student to know the definition and importance of the ILS concept and the elements that make up ILS.

SAMPLES OF BEHAVIOR: Each student will be able to:

a. Define ILS.

b. Describe the need for acquisition logistics.

c. State when in the life cycle ILS is considered.

d. Match the elements of ILS with their definitions.

e. Describe the role of the DPML in the AFSC Program Office.

TOPIC INTRODUCTION:

Now that we have introduced the Systems Engineering process, and the design reviews that allow the government to monitor this process, how do we plan for the support of that technology being developed, and, ultimately produced as a weapon system? The answer is through integrated logistics support. Lesson 10 addresses the concept of Integrated Logistics Support (*ILS*) and how it relates to Department of Defense acquisitions. Obviously, supportability of a weapon system is crucial to our deployment of the weapon system. The latest acquisition reforms witnessed the addition of two new major milestones geared toward analyzing the operational supportability of weapons systems versus what is considered efficient and effective. Logistic support planning begins as soon as the weapon system concept is defined and continues throughout the system's life. This lesson expounds on the elements of ILS, and the role of the Deputy Program Manager for Logistics, with regard to the supportability concept.

METHOD OF INSTRUCTION: Lecture/Discussion

INSTRUCTIONAL MATERIALS:

a. Article: *Integrated Logistics Support*, by Capt Andrews, AFIT/LSY

b. *ILS* videotapes

c. Lesson viewgraphs

AUDIO-VISUAL AIDS: Chalkboard

INSTRUCTIONAL EQUIPMENT: Video monitor and 3/4" tape player

REFERENCES:

a. DOD Directive 5000.39, *Development of Integrated Logistics Support for Systems and Equipment*

b. DOD Instruction 5000.2, *Major System Acquisition Process*

c. AFR 800-8, *Integrated Logistics Support (ILS) Program*

d. AFR 800-2, *Acquisition Program Management*

e. AFR 57-1, *Operational Requirements: Operational Needs, Requirements, and Concepts*

REQUIRED STUDENT PREPARATION:

a. Read article: *Integrated Logistics Support*

b. Scan lesson viewgraphs

DISCUSSION QUESTIONS:

1. A new program has just been approved to enter the concept exploration/definition phase. The appropriate product division has been assigned the responsibility for the development and acquisition; a System Program Office (*SPO*) has been formally chartered and you are assigned as the program manager. The Program Management Directive (*PMD*) directs AFLC to identify a deputy program manager for logistics (*DPML*) to support your program. One day, in walks Maj Ima Loggy, your DPML.

a. After the introductions are over and Maj Loggy has been familiarized with the basic program, what is your first responsibility in assimilating the logistician into the program office?

b. Besides the management responsibility of the elements of logistics as assigned by the program manager, what other areas/disciplines should the logisticians be responsible for or have significant involvement in?

2. You are the program manager for a new aircraft weapon system. Since you are responsible for its supportability, you must ensure all the support resources are available to support the deployed system. Before you can contractually task the contractors for these resources you must know the intended logistics support philosophies. What are a few of the more crucial questions that must be answered before exact logistics support requirements can be identified and acquired.

CRS	Computer Resources Support
DODD	Department of Defense Directive
ICBM	Intercontinental Ballistic Missile
ILS	Integrated Logistics Support
ILSM	Integrated Logistics Support Manager
LCC	Life Cycle Cost
LSA	Logistics Support Analysis
O&M	Operation and Maintenance
PHS&T	Packaging, Handling, Storage & Transportation
SE	Support Equipment
TOs	Technical Order(s)

INTRODUCTION TO ILS

Integrated Logistics Support (*ILS*) begins when a DOD need is identified in a SON, ROC, or other form of direction. ILS follows a weapon system from program inception until it is phased out of the USAF inventory. The program manager, who is responsible for ILS planning and management, will usually assign ILS responsibility to the Deputy Program Manager for Logistics (*DPML*), and, in some cases, to the Integrated Logistics Support Manager (*ILSM*). The ILSM usually works for the DPML and, with complex, major programs, there may be hundreds of functional ILSMs working for one DPML. Some non-major programs may have an ILSM and no requirement for a DPML. In all cases, howeves, the ILS effort is the program manager's responsibility prior to PMRT. After PMRT, the supporting command, (usually AFLC), will assume responsibility for ILS management as well as overall program management. This is not intended to mean that other members of the program office are released from ILS planning. Rather, ILS provides a framework for all program office members to synthesize and integrate all events leading up to the successful generation of a weapon system.

The enormity of this logistics effort demands a structured technique to analyze, quantify, and integrate the totality of the logistics support resource requirements. The system that DOD has employed is Logistics Support Analysis (*LSA*). LSA is simply a vehicle for implementing ILS requirements during the acquisition process. DODD 5000.39, and MIL-STDS-1388-1A and 2A, stipulate more about LSA, but the focus of this course will be on the characteristics and magnitude of ILS.

ILS has become increasingly important to the Air Force as our weapon systems have become more and more complex. This complexity in the weapon systems has made our systems more difficult and expensive to maintain. We have found that the most cost-effective approach is to design our systems with support in mind early in the systems acquisition process.

The systems acquisition process is a myriad of events which must be accomplished for the development, production, and deployment of a system. When viewed from a life cycle cost (*LCC*) perspective, systems go through sequential cost stages. These stages are typically:

a. Research, Development, Test and Evaluation (*RDT&E*)
b. Acquisition
c. Operation and Maintenance (*O&M*)
d. Deactivation/Retirement

When looking at the costs associated with each of these stages, over an extended period of time, it has been discovered that the O&M cost of weapon systems has steadily risen to a point where they now consume more than 50% of the system's total LCC. This will certainly vary markedly when analyzing individual systems, but, when viewed as an average across the DOD spectrum, it still represents a real concern.

Further impacting system LCC is the timing of key program decisions such as: defining the operational scenario, establishing quantitative performance requirements, quantifying the number of systems to be fielded, specifying deployment locations, selecting a maintenance concept, etc. Studies have shown that, by the end of systems concepts studies, 70% of the decisions defining total LCC have been made, 85% by the end

of the system definition, and 95% by the end of full scale deployment. This does not mean actual expenditures; it infers future spending has been committed because of the decisions that were made. It must be added that, once these decisions are made, changing them at a later date could drastically impact program costs. It becomes necessary that changes be evaluated for cost versus benefit before the change is implemented.

Knowing that, on the average, the greatest amount of total LCC dollars are spent on O&M, which really equates to logistics support, and that the vast percentage of total LCC is committed early in the acquisition process, it becomes apparent that logistics planning must begin at the front end of an acquisition program. The remainder of this article will deal with the process of integrated logistics support (*ILS*).

INTEGRATED LOGISTICS SUPPORT (ILS)

In order to understand ILS it is necessary to familiarize yourself with the definition of Acquisition Logistics. It is *The process of systematically identifying and assessing logistics alternatives, analyzing and resolving ILS deficiencies, and managing ILS throughout the acquisition process.* Acquisition logistics, then, is a generic term identifying and describing the overall logistics function within which ILS is the predominant activity. If this is so, then what is ILS? Department of Defense Directive (*DODD*) 5000.39 describes the ILS program as:

> A disciplined, unified and iterative approach to the management and technical activities necessary to:
>
> *a. Integrate support considerations into system equipment design.*
>
> *b. Develop support requirements that are related consistently to readiness objectives, to design, and to each other.*
>
> *c. Acquire the required support.*
>
> *d. Provide the support during the operational phase at minimum cost.*

What is this definition telling us? First, it stipulates that the entire ILS process, when used on a program, must be diligently applied (*disciplined*). No two acquisition programs are alike and, likewise, no two ILS programs in support of an acquisition will be alike. However, all logistics elements must be evaluated for program applicability. When it has been determined what specific elements are necessary they must be pursued methodically. The ILS elements are described individually later in this chapter. Also, inherent in this definition is the uncompromising need for the ILS process to be performed and managed as a single entity (*Unified*). The interrelationship of the ILS elements to each other is such that a change in one could greatly alter requirements in another. This impact could be in cost, schedule performance, design, or even the very need for an element may become questionable.

In order for the ILS program to be effective, it must be periodically and systematically reviewed and updated, as the program progresses (*iterative*). Acquisition programs are extremely dynamic. Numerous factors, both in and out of program office control, change the way a program advances through the acquisition cycle. From the results of internal trade-off studies; to congressional or higher headquarters intervention; to changes in requirements from the using command; all can be equally valid and necessary, but can also be equally devastating to the timely development of the logistics support

structure for a system. All changes must be evaluated for their impact on the ILS elements and the other logistics processes involved in the ILS program. From this, plans must be revised to incorporate the change with minimal disruption and expense to the program and to the system's future logistics support. Simply stated the four functions identified in the definition of ILS mean:

a. As systems are being developed, emphasis must be placed on designing-in, to the maximum extent feasible, those capabilities that improve and enhance logistics support.

b. As the logistics support package for a system is being planned, developed, and produced, a paramount concern must be to obtain the right combination of logistics elements that will maximize system readiness at minimum life cycle cost. It is not only necessary that each logistics element be optimized to the system it will support, but they must also be optimized to each other.

c. Deciding how the logistics support system must function, and its composition, is only part of the challenge. In most programs, industry plays the major role in system planning, design, and fielding. It is incumbent upon the program logisticians to translate logistics requirements into contractual requirements and then, more importantly, to ensure the requirements are met. We must not lose sight of the fact, however, that a significant portion of the logistics resource needed to support a system may come from existing DOD inventory. Therefore, equal attention and coordination must be given to the identification and acquisition of these resources through government agencies.

d. After a system is fielded, the logistics support structure devised for it is put to the true test. It would be unrealistic to expect every facet of the logistics infrastructure established for a system to perform as planned. With this as an accepted given, follow on actions must be pursued to correct deficiencies. In addition, we can expect systems to be modified sometime during their life cycle. ILS planning does not end until a system is retired from the inventory. So the process of planning and implementing logistics support will continually evolve.

ILS ELEMENTS

ILS elements subdivide the ILS program into manageable functional areas and disciplines. You must realize, it doesn't matter whether the program is a large one, like a new Intercontinental Ballistic Missile (*ICBM*), or a small one, like a new helmet for pilots, all logistics elements must be evaluated for applicability to a program. For all practical purposes, what changes between large and small programs is the depth of effort to be performed in each element, even though both programs may have incorporated the same elements into their ILS planning. There is no universal agreement concerning what formally comprises the ILS elements of support. The element descriptions to follow represent the DOD perspective.

1. *Maintenance Planning.* This is the process conducted to evolve and establish maintenance concepts and requirements for the life of the system. In includes, but is not limited to: levels of repair; repair times; testability requirements; support equipment

needs; manpower skills; facilities; interservice, organic and contractor mix of repair responsibilities; site activation; etc. It is this very element that establishes the baseline for planning, development, and acquisition of other logistics support elements. As you read the descriptions of the remaining ILS elements you should ask, ***How would this logistics element be affected by the maintenance concept for the system?*** You'll soon realize the impact in nearly all cases is monumental. It goes without saying that the future holds interesting challenges for maintenance planners. Even now systems are being planned that require innovative maintenance approaches, like: fighter aircraft that will be launched and recovered on a highway rather than a permanent base; mobile ICBMs in nearly a constant state of movement; and, what about the orbital manned space station? The conventional two or three level maintenance concept must, by necessity, give way to a new dimension of maintenance support.

2. *Manpower and Personnel.* This element involves the identification and acquisition of military and civilian personnel with the skills and grades required to operate, maintain, and support systems over the systems lifetime. Early identification is essential. If the needed manpower is an additive requirement to existing manpower levels of an organization, a formalized process of identification and justification must be made to higher authority. Add to this the necessity to train these persons, new and existing, in their respective functions on the new system, and the seriousness of any delays in the accomplishment of this element becomes apparent. In the case of military requirements, manpower needs can, and in many cases do, ripple all the way back to recruiting quotas.

3. *Supply Support.* This element consists of all management actions, procedures, and techniques necessary to determine requirements to acquire, catalog, receive, store, transfer, issue and dispose of spares, repair parts, and supplies. In laymen's terms this means having the right spares, repair parts, and supplies available in the right quantities, at the right place, at the right time. The process includes provisioning for initial support, as well as acquiring, distributing, and replenishing inventories. Keep in mind, an aircraft can be grounded just as quickly for not having the oil to put in the engine as it can for not having the engine.

4. *Support Equipment (SE).* This element is made up of all equipment (mobile or fixed) required to support the operation and maintenance of a system. This includes ground handling and maintenance equipment, tools, metrology and calibration equipment, and manual and automatic test equipment. During the acquisition of DOD systems, we are expected to decrease the proliferation of support equipment into the DOD inventory by minimizing the development of new support equipment and by giving more attention to the use of existing DOD or commercial equipment. Most programs are a mix of common and peculiar (commercial and new design) support equipment. Equal emphasis must be placed on the identification, funding, and acquisition of both. A program office may be making a serious mistake if they think the SE that is currently in the DOD inventory will be available when needed. It may well take longer to get some of the DOD inventory items than it would for new design items provided by the contractor. Another key point must be made. The availability of the prime system can be heavily influenced by the SE used for fault detection/isolation and repair. Much of the SE used

today are repairable items themselves and, therefore, require the timely development and fielding of a logistics support system for the SE as well. This means that SE also need maintenance plans, technical orders, spares, facilities, trained manpower, ts own support equipment, etc. It should thus be obvious that, if the support equipment isn't available because it cannot be repaired, the availability of the prime mission equipment could be affected.

5. *Technical Data.* This element represents recorded information, regardless of form or character (such as manuals and drawings), or scientific or technical nature. Computer programs and related software are not technical data; documentation of computer programs and related software are. Technical Orders (*T.O.s*) and engineering drawings are the most expensive and, probably, the most important data acquisitions made in support of a system. It is the T.O.s that provide the instructions for operation and maintenance of a system. Without them it may be difficult, if not impossible, to operate and/or maintain the prime system and support equipment. Also crucial to a system's LCC is engineering drawings. They allow competitive reprocurement of spare and repair parts, and the modification of systems, which in the long run should minimize the systems LCC.

6. *Training and Training Support.* This element consists of the processes, procedures, techniques, training devices, and equipment used to train civilian and military personnel to operate and support a system. This includes individual and crew training, new equipment training, initial, formal, and on-the-job training. Though the greatest amount of training is accomplished just prior to the fielding of a system, it must be remembered that, in most programs, a fairly large number of individuals must be trained to support the system test program, which can occur several years before system deployment. It is common practice for trainers/training devices to be designed and produced to support a recurring training program. Since a trainer is an end item in itself, it too requires the establishment of a logistics support structure, as was necessary for support equipment and the prime system. The training of operating and maintenance personnel can be seriously impeded if trainers are not usable because technical orders, spares, support equipment, facilities, trained operators, etc., are not available. The less than optimum training of system operators and maintainers could degrade the mission effectiveness and decrease system availability.

7. *Computer Resources Support (CRS).* This element encompasses the facilities, hardware, software, documentation, manpower, and personnel needed to operate and support mission critical computer hardware/software systems. As both prime systems as well as support equipment increase in complexity, more and more software is being used. The expense associated with the design and maintenance of software programs is so high that we can't afford to not manage this process effectively. It is a general standard practice, within each service, to establish some form of a computer resource working group to accomplish the necessary planning and management of computer resources support. As can be seen in its definition, this element does cross the lines of responsibility in other ILS elements (i.e., facilities, manpower, etc.). It becomes a program office decision as to whether all the resource requirements needed to support this element are managed by a

single CRS manager> or by the other appropriate ILS element managers> with the CRS manager monitoring.

8. *Facilities.* This element consists of the permanent and semi-permanent real property assets required to support a system, including studies to define types of facilities or facility improvements, location, space needs, environmental requirements, and equipment. Certainly the non-availability of facilities can be just as damaging to a system as would be the lack of spare parts, trained personnel, or support equipment. The main difficulties associated with this element are in funding and management responsibility. The process of facility design and construction is not routinely funded or managed by the program office, but rather by civil engineering. This could be base level civil engineers, for very small projects, to the Army Corps of Engineering, for projects of any significant size. Facility funds are, in the vast majority of cases, authorized by Congress for specific projects at specified locations and are not transferable. The funding process takes three to four years to complete. Once the process has started, and certainly the closer the time comes to actual construction, the greater the impact will be from any change to facility location. A last minute decision to deploy a system to a different locale may well require extraordinary DOD or, even Congressional action to correct facilities delays. Keep in mind, facility requirements can range from the simple addition of 28 volts DC power to an existing work area, to the design and construction of a multimillion dollar facility. In either case, the absence of the necessary capabilities within a facility, or the absence of the facility itself, will be adversely felt by the prime system the facilities are intended to support.

9. *Packaging, Handling, Storage, and Transportation (P,H,S,&T).* This element is the combination of resources, processes, procedures, design considerations, and methods to ensure that all system, equipment, and support items are preserved, packaged, handled, and transported properly, including environmental considerations, equipment preservation for the short and long storage, and transportability. Packaging is more than cardboard boxes and styrofoam peanuts. Some items require special, environmentally controlled, shock isolated containers for transport to and from a repair facility. A single package like this can cost tens of thousands of dollars. It also comes as no surprise that these types of reusable, repairable containers would also need spare parts, technical data, support equipment, etc. for their own support. P,H,S, & T may be a somewhat overlooked element, but it's not cheap. The reliability of a component can be significantly influenced by how it's packaged, what type of handling equipment and procedures are used, where and how it is stored and the mode of transportation used to get it from the vendor to the eventual user. Transportability, on the other hand, means designing into a system, or an item, the ability to be transported. Trying to routinely transport an item, such as an intermediate maintenance avionics test station that was not designed to be transported, can result in the inoperability of the test station and, therefore, degradation of the repair capability for the items using the tester. Transportability requirement decisions must be made early in the system acquisition process and thoroughly delineated in the system specification.

10. *Design Interface.* This is the relationship of logistics-related design parameters to readiness and support resource requirements. The logistics-related design parameters include:

a. reliability and maintainability

b. human factors

c. system safety

d. survivability and vulnerability

e. hazardous material management

f. standardization and interoperability

g. energy management

h. corrosion

i. nondestructive inspection

j. transportability

These logistics-related design parameters are expressed in operational terms rather than inherent values and specifically relate to system readiness objectives and support costs of the system. Design interface really boils down to evaluating all facets of an acquisition from design to support and, operational concepts for logistical impacts to the system itself, and the logistic infrastructure.

ILS MANAGEMENT

The explanation provided above has only been a thumbnail sketch of the ILS elements. Each element has its own set of processes, procedures and techniques for use in satisfying the requirements of the individual element. However, one must not forget that the *I* in ILS stands for *Integrated.* No program, and more specifically, no logistics element manager, can afford to be so myopic in the management of their individual element(s) that they forget about the extensive inter-relationship of the elements to each other. The administration of any of the logistics elements is a two fold process; the individualized management and attainment of the element, and the optimization of each element to the other elements applicable to a program. It's common practice across DOD to have total responsibility for a systems acquisition levied on a program manager or program director. These responsibilities are cost, schedule, performance and supportability. It is also common for the program manager/director to delegate most, if not all, of the responsibility for establishing the logistics support system to an integrated logistics support manager. This person usually has a moderate to intensive background in acquisition logistics and, depending upon the size of the acquisition program, will have

other logisticians under his control to perform all the tasks necessary to identify, plan and implement the logistics support system.

SUMMARY

The concepts, processes and procedures of ILS and LSA are certainly no panacea for all the ills associated with the acquisition and support of new or developing systems. The precepts of ILS do provide a process which can more thoroughly examine the requirements for supporting equipment vital to our defense needs. This thorough, systematic approach to logistics support is mandatory in the prevailing climate of cost-effectiveness. The optimum balance between performance and life cycle cost can only be achieved by including logistics support considerations in all phases of the system's life cycle.

DEFINITION OF ILS

A UNIFIED AND ITERATIVE APPROACH TO THE MANAGEMENT AND TECHNICAL ACTIVITIES NECESSARY TO:

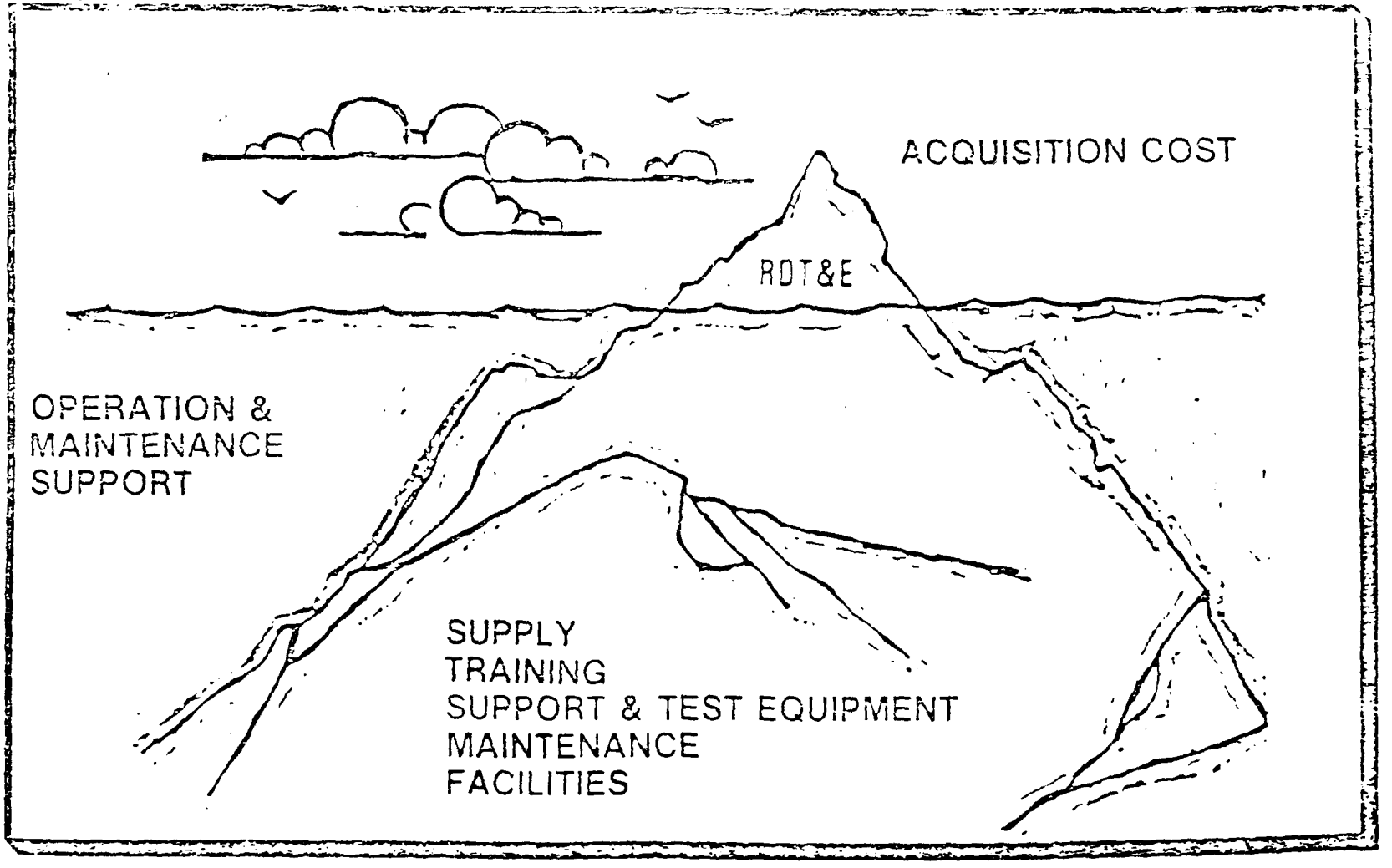
(1) CAUSE SUPPORT CONSIDERATIONS TO INFLUENCE BOTH REQUIREMENTS AND DESIGN.

(2) DEFINE SUPPORT REQUIREMENTS THAT ARE OPTIMALLY RELATED TO THE DESIGN AND TO EACH OTHER.

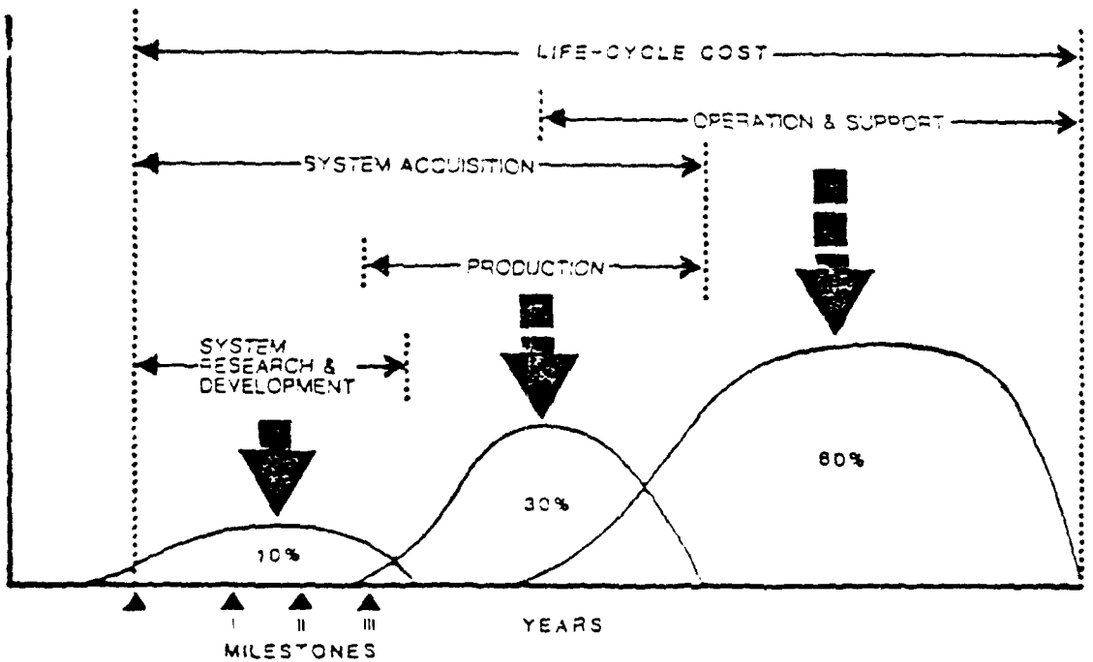
(3) ACQUIRE THE REQUIRED SUPPORT.

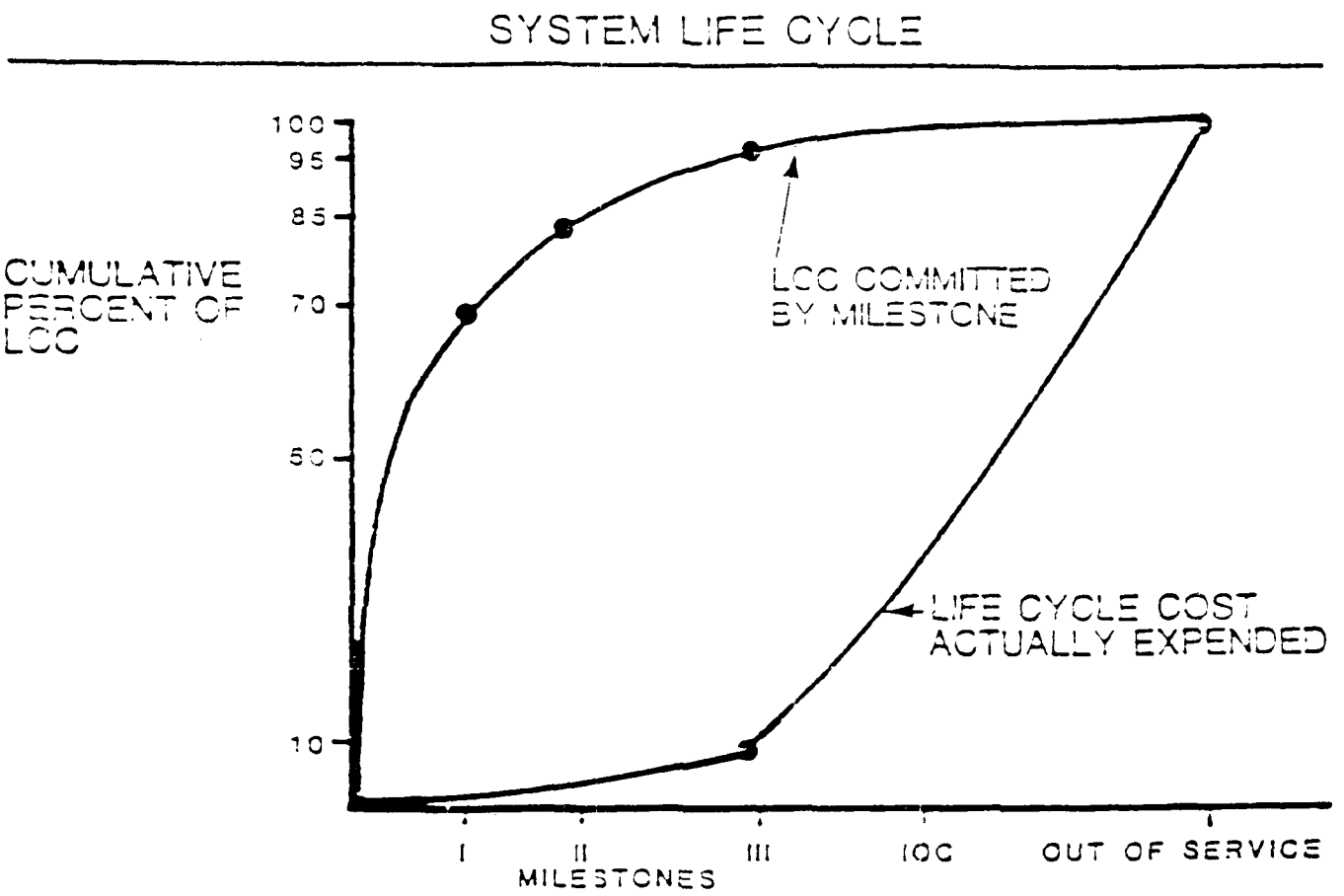
(4) PROVIDE FOR THE REQUIRED SUPPORT IN THE OPERATIONAL PHASE AT MINIMUM COST.

TOTAL COST OF OWNERSHIP



Typical System Life Cycle Cost Distribution





Typical System Life Cycle Cost Commitment

WHEN DOES ILS PLANNING BEGIN?

- o STATEMENT OF OPERATIONAL NEED (SON)
- o JUSTIFICATION FOR MAJOR SYSTEM NEW START (JMSNS)*
- o SYSTEM OPERATIONAL CONCEPT (SOC)**

[* now known as Mission Need Statement (*MNS*)]
[** now known as System Operational Requirements Document]

HOW DOES ILS PLANNING EVOLVE?

- o PROGRAM MANAGEMENT DIRECTIVE (PMD)
- o PROGRAM MANAGEMENT PLAN (PMP) SECTION 9
- o INTEGRATED LOGISTICS SUPPORT PLAN (ILSP)
- o INTEGRATED SUPPORT PLAN (ISP)

WHEN DOES ILS PLANNING END?

- o WHEN SYSTEM/EQUIPMENT IS PHASED OUT OF INVENTORY

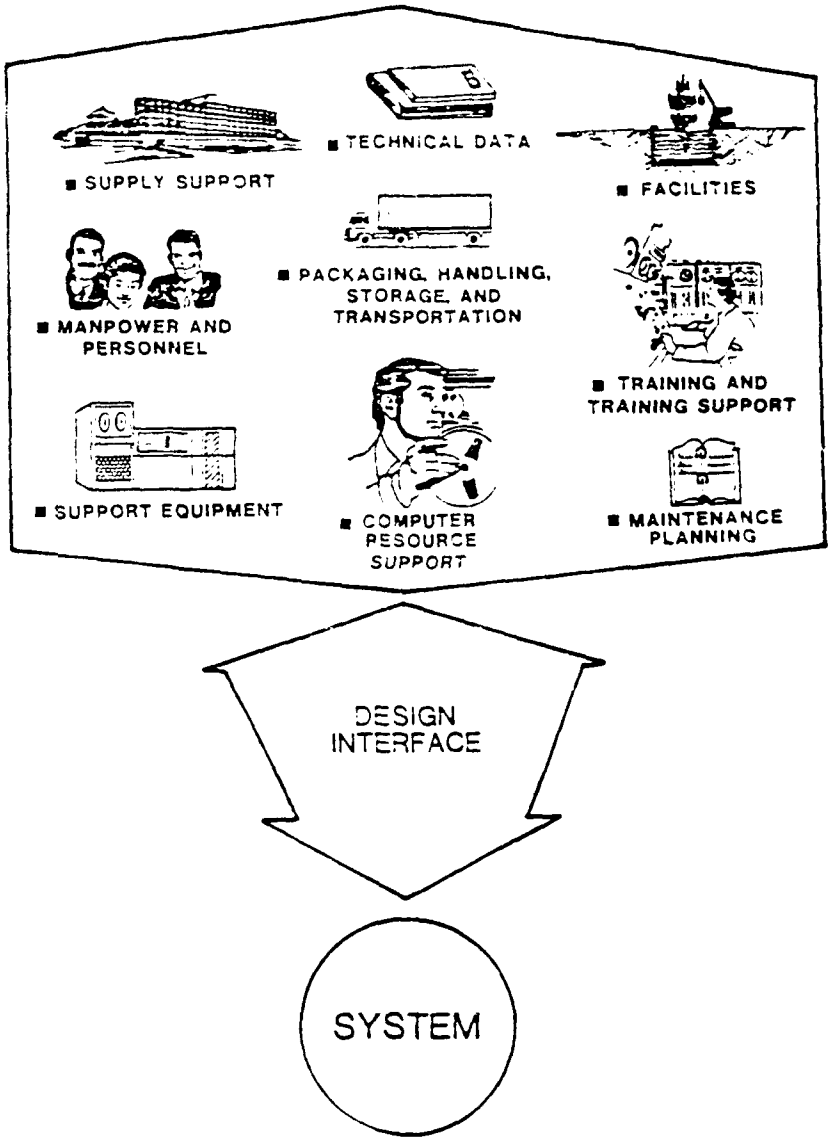
WHO IS RESPONSIBLE FOR ILS PLANNING?

- o BEFORE PMRT -- PROGRAM MANAGER
- o AFTER PMRT -- SYSTEM PROGRAM MANAGER

ILS OBJECTIVE

TO HELP ACHIEVE AND SUSTAIN A REQUIRED READINESS POSTURE AT MINIMUM LIFE CYCLE COST

The ILS Elements



LESSON 11

LESSON TITLE: **Configuration Management**

TIME: 2.5 hrs

LESSON OBJECTIVE: The objective of this lesson is for each student to know the four primary functions of configuration management as they pertain to the system acquisition process.

SAMPLES OF BEHAVIOR: Each student will be able to:

a. List the four main configuration management functions.

b. Define what constitutes configuration identification.

c. Identify which baseline is used to control which level of documentation detail.

d. State the purpose of the Functional Configuration Audit (*FCA*).

e. State the purpose of the Physical Configuration Audit (*PCA*).

f. State the purpose of configuration control.

g. Identify the five main areas of emphasis in configuration status accounting.

TOPIC INTRODUCTION:

With the emphasis on integrated logistics support, one needs a method or discipline that allows acquisition and support people to identify and document the characteristics of a development program, control changes to those characteristics, and record and report change processing and implementation status. This is the definition of configuration management. It would be very difficult, at best, for support planning, and its implementation, if we did not know what the weapon system could do, what it looked like, what it could interface with, how hot it could get, etc., or, as referred to in this lesson, what it was *configured like*. This lesson addresses the four main configuration functions, the different baselines and audits in support of those functions, and the concept of configuration control and status accounting.

METHOD OF INSTRUCTION: Lecture/Discussion

INSTRUCTIONAL MATERIALS:

a. Article: *We Still Worry About Configuration Management*, by Mr Bill Dean, AFIT/LSY

b. *Configuration Management* videotapes

c. Lesson viewgraphs

AUDIO-VISUAL AIDS: Chalkboard

INSTRUCTIONAL EQUIPMENT: Video monitor and 3/4" tape player

REFERENCES:

a. AFSCP 800-7, *Configuration Management*

b. AFR 65-3, *Configuration Management*

REQUIRED STUDENT PREPARATION:

a. Read article: *We Still Worry About Configuration Management*

b. Scan lesson viewgraphs

DISCUSSION QUESTIONS:

1. The program has completed most of the Demonstration/Validation phase. Col I. M. Boss, the program director for your new missile program, is concerned about establishing the Functional Baseline this early in the program. He would like to wait until later to establish it. He still does not feel sure that the government has enough information to really know what the system requirements are, and he is reluctant to have to make (and pay for) sweeping changes to the requirements later via Engineering Change Proposal. He contends that we can wait until later in the Full Scale Development phase to establish the baseline and continue to make changes to the requirements without needing ECPs and without having to pay for them.

a. When is the Functional Baseline supposed to be established? Why?

b. Is it permissible to delay the establishment of this baseline as the colonel proposes? Is it wise?

c. What impact would this delaying policy have on the contractor's design effort? On the government's control over the contractor's design?

2. While reviewing the draft of the first (of many) configuration item development specifications, the configuration manager notices that there is no cross-referencing between the requirements and the quality assurance provisions in the specification. She recommends that a cross-reference matrix, similar to one shown in MIL-STD-483, be incorporated in each specification. The contractor says that the matrix is not required by the contract, and that such a matrix will boost the price of each specification (there will be 30 for your program), by approximately $3000.

a. How will the matrix benefit the program office? The contractor? Would it be worth the money the contractor is quoting?

b. What could be done on future contracts for other programs to be sure that a matrix will be in the specifications?

3. You are a member of the government Executive Panel reviewing problem areas identified by members of your Functional Configuration Audit team. If they are valid,

they should be submitted to the contractor for comment and/or correction. In this case, Mr. D. Zeiner has reviewed the test results for the contractor's design of the guidance computer; while the design has met the specification requirements, Mr. Zeiner is aware of a recent development in microprocessors that is much faster and more reliable. In his writeup, he wants to direct the contractor to incorporate the new microprocessor design into the missile guidance computer.

a. Should the Executive Panel approve the writeup and submit it to the contractor? Why?

b. What should Mr. Zeiner do to try to incorporate the new microprocessor into the missile guidance computer?

4. After the Critical Design Review, the contractor builds a few prototype units of the guidance CI and tests them. During the testing, the detail design of the inertial reference unit in the guidance subsystem proves to be deficient and must be redesigned. The contractor submits an Engineering Change Proposal for the redesign and retesting effort, at a cost of $365,000.

a. If this is a Fixed Price contract, what should you do with the ECP? Would the process be different if it is a Cost Reimbursement contract?

b. When, in the program life cycle, would we have to start considering these ECPs? Why?

[Acronyms introduced in this lesson, and their description]

Chapter 11

ACSN	Advanced Change/Study Notices
CM	Configuration Management
ECPs	Engineering Change Proposals
TBD	To Be Determined

WE STILL WORRY ABOUT CONFIGURATION MANAGEMENT

By William A. Dean

When your next production unit is delivered, will you know what to check, to be sure it is the correct design? When the first unit is delivered incorporating that new, high reliability black box, will the corresponding technical manuals and automatic test equipment be available to support it? When the contractor completes the qualification test program, can you be sure that the design really meets your mission requirements? If you've ever been faced with these concerns, configuration management (*CM*) has some answers for you.

WHAT IS CONFIGURATION MANAGEMENT?

CM is comprised of a set of engineering management practices and procedures that are applied in four basic areas of emphasis:

(1) *Configuration Identification*: the documentation of the functional and physical characteristics of the system and its component hardware and software.

(2) *Configuration Audits*: the review of the results of the contractor's development effort to assure that government requirements have been fulfilled in the design and to assure that the detail design has been accurately documented.

(3) *Configuration Control*: the communication/decision making process used to completely document and control changes to the contractually binding configuration identification.

(4) *Configuration Status Accounting*: the information system used to provide traceability of the documentation and delivered units and of the changes to both.

Those are a few very simple words that describe a critical process that must extend over the entire life cycle of a system. But there is nothing mysterious about CM. The practices that are used are based on the tailoring of common sense management practices to the way the DOD acquires and supports its weapon system hardware and software.

-- If you were going out to buy a bit for an electric drill, you wouldn't buy the first one you saw. You'd have to think first about whether it was for drilling in wood or metal or masonry, what diameter hole you had to drill, and what was the maximum size bit your drill chuck could accept. In short, you'd think first about what you wanted it to do and what the interface constraints were. That's just common sense. Likewise, when the DOD goes out to develop a new missile, we first must define what we want it to do, so that the contractor will design a missile that meets our needs. (CONFIGURATION IDENTIFICATION)

-- If you're building a new house, and you've asked for some special fixtures or upgraded carpeting to be installed in it, you will conduct an inspection to make sure the builder complied with your agreement. Likewise, when the missile has been developed, we will have to check to make sure that the contractor's design has been tested to prove that it meets our requirements. (CONFIGURATION AUDITS)

-- If you've ordered a relish tray to be delivered on Saturday evening for a party you're having, the caterer can't deliver finger sandwiches to you on Wednesday and expect payment for them. Business law (if not common sense) protects you in that type of situation. Likewise, you don't want your missile contractor to delay the delivery of production units or change the design of any of the installed components without your permission. (CONFIGURATION CONTROL)

-- If you go to the Sears Parts Department to get a replacement part for your garage door opener, you give them the exact model number, and you expect that they will have records of the exact replacement part number (and supplies of the part) you need. Likewise, when a component on the missile fails, we need to have exact records (part numbers, drawings, and manuals) of the missile configuration so that we can identify and obtain the part we need to fix it. (CONFIGURATION STATUS ACCOUNTING)

CM requires careful selection and acquisition of the documentation that describes the unit or system we are buying. The documentation provides the basis for determining whether the unit meets our performance requirements, for establishing a logistics support system for the system, and for Government acceptance of production units. Once the documentation has been placed on contract, CM requires the contractor to communicate with the government and, get Government agreement before making any change to the documentation. In communicating information about the change, the contractor must summarize the total impact, especially the impact on the logistics support system. And, once the change has been approved, CM requires the Government to track the implementation of the change to be sure all new hardware, spares, manuals, etc., are available as proposed. CM, at the bottom line, is required to assure the continuing LOGISTICS SUPPORTABILITY of systems in the Government inventory.

In trying to understand CM, one needs first to understand what is meant by configuration. The physical aspects of a configuration are easy to understand. Everyone understands what is meant by the *physical configuration* when looking at the actual hardware, at the drawings and parts lists that define the hardware design, or at the line-by-line listing representing the software design. On the other hand, few people consider that a set of performance requirements and constraints in a specification also constitutes a *configuration* -- the *functional configuration.* But early in the development of a new system, before the design and testing efforts have been completed, the only available description of the system is in terms of the *functional (performance requirements) configuration.* Since the physical design will evolve based on these requirements, it is as critical to accurately define and control the functional configuration during development (and throughout the life of the system) as it is to accurately define and control the physical configuration of the units in operational use.

The basic unit of CM is the configuration item (*CI*). Essentially all of the CM functions are performed at the CI level. Specifications are written to document the characteristics of each CI, the design reviews and audits are performed for each CI, engineering change proposals are written separately for each CI affected by the change, and status accounting tracks the implementation of changes to each CI. The exception is that a SYSTEM specification will be written for each major system to define the required performance, and a Formal Qualification Review will usually be required to verify that the system performance has been met.

The CI is defined as *an aggregation of hardware/computer programs, or any of their discrete portions, which satisfy an end-use function* . . . . During development and qualification testing, CIs are usually those assemblies of components (such as an air-to-air missile, the guidance unit in the missile, and the guidance software) which are considered critical during development to successful achievement of the system performance. By designating them as CIs, we are saying that they are important enough to deserve separate requirements documentation (specifications and related documents) and careful technical monitoring (reviews and audits) during design and testing. Once the design has been qualified, a few additional CIs may be selected, for logistics reasons, from among the major components of a CI (such as a critical black box, a complex printed circuit board, or a special gyroscope for the guidance unit) and which require separate documentation and control in order to facilitate their competitive reprocurement as spares. (Most spare parts, however, do not have to be CIs in order to be competitively reprocured).

Configuration Identification

Configuration identification includes the specifications, and their associated diagrams, flow charts, drawings, parts lists, etc., that are used to describe the functional and physical characteristics of a CI. The process of controlling the configuration identification requires the Government to establish baselines, using various elements of the documentation, which are expected to have achieved a certain level of definition (degree of maturity) by an appropriate milestone in the program. The exact time of the establishment of the baselines is dependent upon the type of program involved, but the configuration manager should have a key input in the timing, and in the type, of documentation required.

The functional baseline is used to document the functional (performance, operational, logistics, training, etc.) requirements/constraints for the total system. It usually consists of a single specification (system specification) describing the essential requirements for the basic functional elements (both hardware and software) of the system. The system specification will usually contain all of the requirements and constraints that comprise the TECHNICAL BASELINE established between HQ USAF/DOD and the program manager as a part of the PROGRAM BASELINE. The functional baseline is usually established at the end of the Concept Exploration phase, or at the beginning of the Demonstration/Validation phase, of the program. It establishes the TECHNICAL BASIS for the contractor's analysis and breakout of the system elements and their related requirements. It represents a contractual agreement between the government and the contractor concerning the expected technical outcome of the development process. The requirements, and related quality assurance provisions in the system specification, provide the basis for most of the operational testing of the system.

The allocated baseline is used to document the functional (e.g., performance, operational, and logistics) requirements for each CI. (For larger systems, there may be tens or hundreds of allocated baselines -- one for each CI comprising the system.) The allocated baseline is really an expansion of the (system) functional baseline to more completely define the functional characteristics of the important pieces (*CIs*) of the system. The allocated baseline for each CI is documented in a (hardware CI) development specification or (software CI) requirements specification. The requirements in the specification are the basis for the contractor's design of the CI; the quality assurance

provisions in the specification form the framework for the qualification (development, and some operational) testing of the CI. The allocated baseline is usually established at the end of the Demonstration/Validation phase, or very early in the Full-Scale Development phase, of a program. The Allocated Baselines establish the TECHNICAL BASIS for the contractor's design, development, and testing of the CI's prototype production configuration during the Full Scale Development phase.

The product baseline is used to document the detail design of the CI which meets the requirements of the functional and the allocated baselines. A product baseline will be established for each CI after the contractor has successfully demonstrated that it meets the specified performance (see Functional Configuration Audit) and after the government has conducted a design verification (see Physical Configuration Audit) of a production (or production-like) unit. The product specification requirements define the physical design of, and the acceptance criteria (performance values) for, each production item. The acceptance tests required by the quality assurance section of the product specification will be performed on each production unit (or lot of such units) and must be successfully passed before the Government will accept the unit (or lot). The product baseline is usually established early in the production phase of the program, when a production unit is available, but it may be established at or near the end of the Full-Scale Development phase, if the production contractor has not been preselected. The Product Baseline establishes the TECHNICAL BASIS for the manufacture and acceptance of the CI during the Production phase of the program.

Configuration Audits (and Design Reviews)

The purpose of the design reviews and the configuration audits is to review the contractor's system engineering (both design and test) efforts, as progressive increments of the configuration identification and test documentation are generated. Although the design reviews are engineering functions, they complement the establishment of the baselines. Thus, they are closely tied to good CM.

-- The Systems Requirements Review (*SRR*) is used for the system to review the adequacy and completeness of the functional configuration identification (system specification) before establishing the functional baseline. This System Specification will often carry some requirements as *To Be Determined* (*TBD*) or goals through the Demonstration/Validation phase. It is normally accomplished late in the Concept Exploration/ Definition phase or at the beginning of the Concept Demonstration/ Validation phase.

-- The System Design Review (*SDR*) [or the Software Specification Review (*SSR*)] is used for each CI to review the adequacy and completeness of the allocated configuration identification (development specification) before establishing its allocated baseline. A follow-on SRR, or a system-level SDR, may also be used for the system in this time frame to finalize the TBD requirements and goals, before their incorporation by ECP in the System Specification. The series of reviews are normally accomplished during the Concept Demonstration/Validation phase and should be completed early in the Full Scale Development phase.

-- The Preliminary Design Review (*PDR*) is used for each CI to address its functional elements and their related performance constraints, as selected and defined by the contractor's systems engineering analyses, prior to proceeding with the detail design. It

is used to assess the chances that the selected functional elements will meet all of the CI's specified (allocated baseline) performance requirements. The series of reviews is normally completed early in the FSD phase.

-- The Critical Design Review (*CDR*) is used for each CI to address the contractor's detail design drawings (or Software Detail Design Documentation) prior to releasing them for manufacture/coding of qualification test (pre-production) articles. It is used to assess the chances that the selected detail design elements will meet all of the CI's specified (allocated baseline) performance requirements. The series of reviews is normally completed during the first half of the FSD phase.

-- The Test Readiness Review (*TRR*) is used for each software CI to review the results of the informal testing of the units and components of the software CI and to review the test procedures to be used to test the software CI. It is used to assure that the software CI is ready for CI-level testing. The series of reviews is normally completed near the middle of the FSD phase.

At each of these design reviews, an additional increment of system/CI documentation has been generated. The purpose of each review is to detect and correct errors in this increment of documentation (and to realign the contractor's design effort), if possible, before further CI design/testing effort is undertaken based on the content of this increment.

The audits, to use Webster's definition, are a check of *the final statement of account* of the development program.

-- The Functional Configuration Audit (*FCA*) is used for each CI, to check the results of its qualification testing, in order to verify that CI performance meets or exceeds development specification (allocated baseline) requirements. The series of audits is normally accomplished at the end of the FSD phase.

-- The Formal Qualification Review (*FQR*) is used for the system to check the results of the system-level qualification testing, in order to verify that all system elements meet or exceed their system specification (functional baseline) requirements. It is held, if required, at the end of the FSD phase or, early in the Production phase.

-- The Physical Configuration Audit (*PCA*) is used for each CI to verify that the detail design documentation referenced in the CI's product specification matches the design of a unit being delivered to the government and to verify that the contractor's engineering (change) release system is able to control the release of changes to the detail design documentation. The series of audits is held near the beginning of the Production phase when a unit of the operational configuration is available. A series of audits may be accomplished at the end of the FSD phase if the production contract is to be competed.

The audits are used to verify the quality of the contractor's full-scale development effort prior to the Government's taking control of the detail design (with the Product Baseline) and authorizing acceptance and operation of the production units.

Configuration Control

Configuration control implies the control of the baseline documentation. However, it also requires communication about the full impact of proposed changes. Contrary to popular belief, configuration control procedures, including the use of formal Engineering Change Proposals (*ECPs*), must be implemented once the functional baseline

(system specification) has been established. When the allocated and product baselines are established later in the program, formal ECPs are then required to be submitted and approved before changes can be made to their baselined documentation. Once the product baseline has been established, even minor (Class II) changes to the baselined detail design documentation require Government agreement before they may be implemented.

Configuration control requires that sufficient information be provided in the ECP to completely document all impacts of the change. The impact on all system elements and contract requirements must be discussed. During the development phases, the ECP content is relatively simple. It will describe specification wording changes, describe changes in the test program that result from the specification changes, and, in some cases, describe the general qualitative impact of the change of the life cycle cost, logistics support, and operational capabilities of the system. During the production and operational phases, much more information must be provided in the ECP. A detailed description of changes in part design, requirements for retrofit/rework of already delivered units, and specific impacts on the logistics support system (spares, manuals, tools, etc.) must be included, in order for the program office to assess the total impact of the change. The bottom line of configuration control, during production and operation, is to assure the continued logistics supportability of the new (and the old) configuration, once the change is approved and implemented.

Configuration control is not just something which must exist between the Government and contractors. Once the production is complete, the contractor disappears from the picture. However, there is still a requirement for the Government Management Activity to control changes generated by a Government Engineering (Design) Activity. All of the impact information (formerly provided by the contractor) must be provided by the Design Activity and the proposed change approved by the Management Activity. Channels for official documentation and approval of the proposed changes are similar to those used when the contractor was involved. These channels must be established, and utilized, if configuration control is to be maintained for the delivered items throughout their operational life.

Configuration control also implies the management of the number of changes being submitted by the contractor, such that the program office will not be deluged with ECPs. Many programs require the contractor to obtain permission from the program office (contracting officer) before a routine ECP may be prepared. Preliminary communication about change ideas between the program office and the contractor will help to reduce the costs of preparation of unwanted, or incomplete, formal proposals. Preliminary ECPs and Advanced Change/Study Notices (*ACSNs*) are often used for this purpose.

Configuration Status Accounting

Status accounting provides traceability of the documentation, units, and activities resulting from the other three areas of CM. However, the actual role of status accounting is probably the least understood area of CM. If is often perceived as a set of very expensive and voluminous computerized reports used to track the implementation of approved changes. Large programs seem to need them and pay a great deal of money for them; small programs seem unable to afford them. Actually, however, status accounting is a management function which requires a source of management information: the reports

are only one means of obtaining this information. Using this management information, status accounting policy requires that we maintain traceability of the following CM activities:

-- All changes must be carefully tracked from the time the idea is first recorded officially (in an Advanced Change/Study Notice, contractor or program office letter, preliminary ECP, formal ECP, or other document) until the time it is disapproved, or approved, and officially incorporated into the contract. The intent is to expedite the processing of changes and to assure that changes are not lost or delayed during processing.

-- The implementation of approved changes must be tracked after they are placed on contract. In the ECP, the contractor has identified all impacts to the program documentation and has provided a schedule for incorporating all changes into the production line, the operational units, and the logistics support system. Status accounting requires tracking of all these actions, to make sure they are accomplished as proposed, or to identify problems early enough to develop temporary alternative measures, thereby preventing disruption of the operational/logistics capabilities. Sometimes, status accounting managers require very detailed change implementation tracking information to be provided. They monitor detailed milestones in the development of new/revised manuals, acquisition of new spares, and revision of support equipment software, among other impacts, due to a change to the product baseline. For retrofit/rework changes, they track the development and delivery of the kits of modification parts and the associated installation/checkout instructions. In most cases, they record the actual installation of these kits in operational units.

-- An up-to-date record of, and historical data about, identification numbers (e.g., part numbers, model numbers, nomenclature) and document numbers must be maintained for each CI.

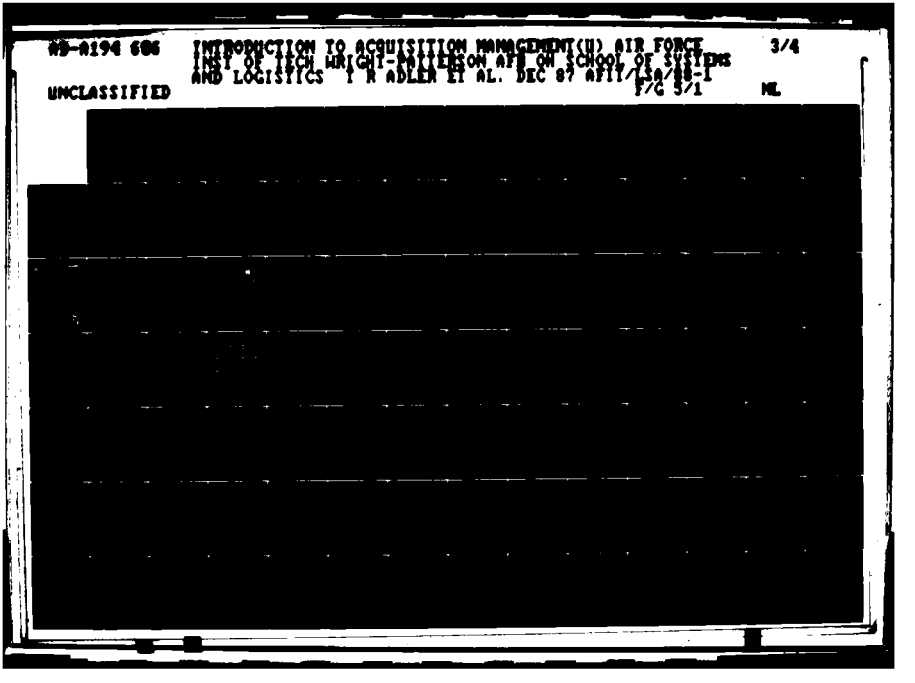
-- Tracking of all approved ECPs for each CI, and the production incorporation point (serial number effectivity) of the change, must always be tracked.

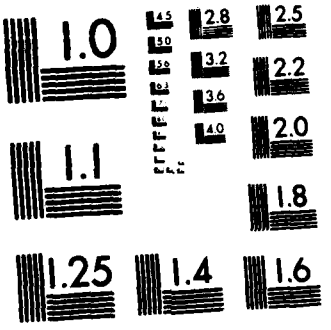
-- The configuration of all units in the field must be continuously tracked. In some cases, this requires only part number control of the components installed in a configuration item or system; in others, there must be part number and serial number (and, sometimes, time of operation) control of certain critical components. Differences in the configuration of similar units must be documented and tracked to ease their support and modification. Otherwise, a proliferation of unknown quantities of units with different configurations can invalidate the program documentation and complicate the logistics support system.

But, whether all of this tracking is accomplished by reviewing formal reports, by weekly phone conversations with the contractor, by Government plant representative checks, or by a combination of all of these, the tracking of these elements must be accomplished. The amount and type of detailed information required for your program is your decision, the means of tracking will be determined by your program, but the accomplishment of the tracking is required.

AD-A194 606 INTRODUCTION TO ACQUISITION MANAGEMENT(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF SYSTEMS AND LOGISTICS I R ADLER ET AL. DEC 87 AFIT/LSA/88-1 3/4

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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Who Needs Military Standards?

As a program manager who applies CM, you should understand it as a management philosophy and should understand why there are requirements for certain events, documentation, and milestones in your program. The actual implementation of CM will be determined by the size and complexity of your program, by the type of hardware and software involved, by the phase of the acquisition cycle, by the expected production quantity, by the expected operational deployment, etc. Sometimes, schedule or money constraints may preclude the complete accomplishment of every CM activity. However, the key is to accomplish at least the INTENT of the CM activities as you proceed with the program, even if you are unable to accomplish the complete scope of each of the activities. Care must be taken, however, in deviating from the basic requirements spelled out in the military standards.

The policy in the DOD Directive, and in the CM Regulations of the various services and agencies, prescribe specific CM program requirements in policy language and require DOD personnel to accomplish certain activities in the CM area. However, those requirements cannot be placed on contracts. The military standards prescribe specific CM program requirements in contractual language and are intended for contractual application. They have been written, and revised, based on problems encountered (and lessons learned) in other DOD programs. The requirements in the military standards may be tailored to delete unnecessary detail from the program, or they may be waived and deleted entirely from the program if they are inappropriate to the program. Indiscriminate tailoring or deletion, however, may lead to insufficient documentation and control of system design, may create communications problems in the understanding of contractual tasks, and will eventually lead to problems with the logistics support for your system.

The standards provide uniform terminology to be used in communicating about CM between the Government and most DOD contractors. For example, if I speak of a Critical Design Review, the contractor understands the intent of that type of review and will know where to go (for this example, MIL-STD-1521), to find additional detail on what type of documentation will need to be available and what activities will be accomplished. On the other hand, if I speak of a Technical Documentation Review, the contractor will need a detailed description of it in the statement of work and, even then, may not fully understand its purpose. To cite another example, the contractor will know what information is to be included in a Prime Item Development specification by reviewing MIL-STD-490, and we know what to look for in reviewing it. But the contractor may experience problems in defining the required performance for a CI if we ask for a "Technical Exhibit" to specify the requirements. The "exhibit" may include too few (or too many) requirements. It may not provide adequate constraints to guide the contractor's design process, or it may unnecessarily restrict design flexibility. Or the "exhibit" may omit the detailed qualification tests contractually defining how each requirement will be tested in order to verify the adequacy of the design. By following the MIL-STD-490 requirements, we are assured of specifying adequate, but not excessive, technical requirements for the system and its component CIs.

The military standards provide for a common understanding of contractual tasks between the DOD and the contractors. The tasks associated with the standards are well defined and understood. If this is the first Government contract for a contractor, the use

of the military standards will help the contractor to understand the scope of effort required. After the completion of the first contract, the standards allow the contractor to utilize an established data base in estimating the work effort involved in performing similar tasks on future contracts.

The following are the principal military standards utilized to implement CM on our contracts. Since they are often revised, the specific revisions are not shown with the basic document numbers.

-- DOD-STD-480 (and MIL-STD-481, for some reprocurement contracts) establishes the requirements for submittal of ECPs, deviations, and waivers. It also defines the amount and type of information which should be included with the documents.

-- MIL-STD-482 establishes format requirements for various data elements and provides a guide to the codes for data elements used in status accounting information systems.

-- MIL-STD-483 (USAF) is used by the Air Force to supplement the requirements specified in the other standards and to provide contractual requirements in areas not covered by the other standards.

-- MIL-STD-490 defines the criteria for selection of various types of program-peculiar specifications for use as program configuration identification; it also contains an appendix, for each type of specification, in which it delineates the various requirements paragraphs which must be included in the specification.

-- MIL-STD-1521 (USAF) contains general requirements relating to the accomplishment of all reviews and audits; it also contains an appendix, for each review and audit, in which it spells out the details of tasks to be accomplished and documentation to be available at that review or audit.

These are the primary CM standards; their tailored application to various programs must be accomplished very carefully. The tailoring of these military standards for CM should be accomplished with the advice of your configuration managers. They understand the needs of the program, as well as the philosophy of CM, and can help you to specify adequate CM tasks and activities. (The same is also true for the selection of data items necessary to accomplish or document the tasks required by the military standards.) Tailoring guides are included in appendices of MIL-STD-1521 and DOD-STD-480 to aid in their contractual application.

In addition to these primary standards, there are many associated documents. DOD-STD-100 (with specification DOD-D-1000) is available for guidance in obtaining engineering drawings and associated lists for the programs; it also provides criteria for controlling changes to part numbers. Military specification MIL-S-83490 establishes criteria used for specifying the degree to which program-peculiar specifications must comply with the MIL-STD-490 format and content requirements. MIL-STD-499 provides requirements for the contractor's (systems) engineering management program; it is supplemented by the requirements for the design reviews and configuration audits in MIL-STD-1521. MIL-STD-961, as an alternative to MIL-STD-490, provides the format and content requirements for military (e.g., MIL-A-12345) specifications.

Problems for the Program Manager.

Given this brief description of Configuration Management, you can see that it is a common sense approach to a critical area of systems program management. By incorporating adequate CM into your program, you will be assuring your ability to define and control the configuration of the operational units and to facilitate the logistics support of those units. The question is, *Where will you find the person with the qualifications to accomplish these CM tasks for you?*

For many years, configuration managers were characterized as *Configuration Recorders*, required merely to track and record the accomplishment of various program activities without participating in the initial decisions about the tasks. Configuration managers had a reputation as *paper pushers* and as *road blocks*. While some of the CM responsibilities do require administrative documentation of various program activities, and adequate control of the configuration does require time to accomplish a complete review and official decisions before changes to the contract are authorized, practical management demands that these necessary activities be accomplished. Yet, in the past, the configuration manager has received little recognition or praise for diligent, painstaking efforts for the program and outstanding management advice to the program manager. Configuration managers often have the greatest awareness of the overall project status of anyone in the program except the program manager. But they often feel that other functional managers receive more recognition and are more likely to be promoted. So, the configuration manager will spend a year or two in CM learning about program management and then transfer to some other functional management area where the promotion potential appears to be better.

If there is to be effective program management, there is a need to change this situation. We need to establish a viable career progression for the configuration manager if we are to retain our best talent. The responsibility for program recommendations in the CM area should be delegated to the configuration managers. The configuration manager should participate in the program planning sessions coequal with the engineers, test planners, logisticians, and other functional experts. The experienced configuration managers have the expertise in that functional area, the familiarity with most other functional management areas, and the insight into the program needs necessary to construct a suitable CM system. But, if they have transferred to another program office in some other functional management job, you won't be able to get the help you need in your initial program decisions. And you can't expect a brand new configuration manager to have the necessary understanding.

There is also a need to familiarize all system program management functional personnel with the philosophy of CM. (For that matter, there is a need to familiarize all program management personnel with all the functional management philosophies.) This will help dispel their misconceptions about the effects of CM on, and the role of the configuration manager in, their day-to-day activities.

Also, since the tracking of the actual configuration of operational units requires the input of information from operational maintenance personnel, there is a need to address the reasons for, and effects of, CM and configuration control in the various maintenance training courses they attend. We need to instill, in the maintenance personnel, an appreciation of what increased configuration (proliferation) control can do to decrease or simplify their workload. Otherwise, we will continue to experience control

problems, and information inaccuracies, at the operational level.

WHY WORRY ABOUT CONFIGURATION MANAGEMENT?

As mentioned earlier, the ultimate intent of configuration management is to facilitate and simplify the logistics support of your system. I can't guarantee that you'll have no logistics support problems if you have good configuration management on your program. You'll minimize them, certainly, but there's no way that anyone can totally prevent logistics support problems. However, if you have poor configuration management on your program, I can absolutely guarantee you that you'll have many logistics support problems. Configuration management requires money and manpower to accomplish, and time (delays) are usually required to accomplish the necessary reviews, whether we're checking a draft specification or an engineering change proposal. But configuration management is based on good management practices, so the effort is necessary and cost effective.

It comes right down to that old adage, *You can pay me now, or you can pay me later*. You're going to have to pay now to implement effective configuration management on your program, or you're going to pay later for lack of configuration management, and you'll probably pay many times more, then. It just makes good sense to follow your common sense management instincts, to implement effective configuration management practices right from the start on your program, and thus to avoid the logistics support and inventory management nightmares that have often resulted from poor configuration management on past programs.

If we are to have good CM on our programs in the future, we need to take the actions now which will preserve and improve our resources of CM expertise and our practice of CM throughout the program life cycle.

TWO FACETS OF CONFIGURATION

PHYSICAL

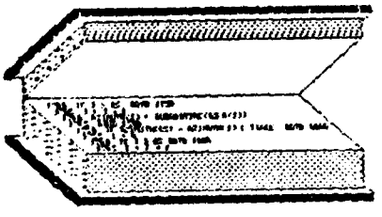
- DRAWINGS
- PARTS LISTS
- SOFTWARE LISTINGS

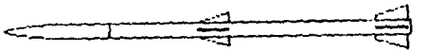
FUNCTIONAL

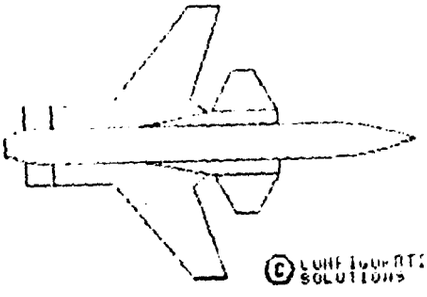
- LOGISTICS CONSTRAINTS
- INTERFACE REQUIREMENTS
- PERFORMANCE REQUIREMENTS

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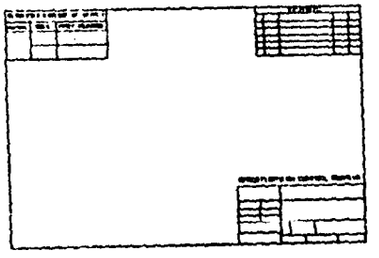
PHYSICAL



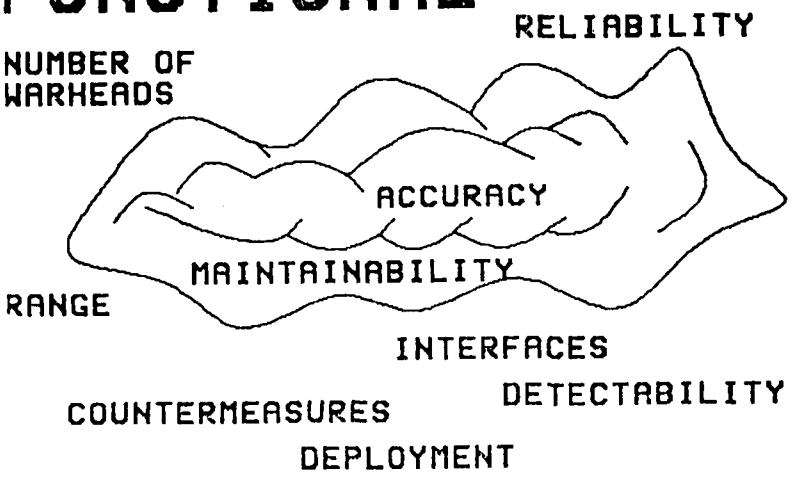




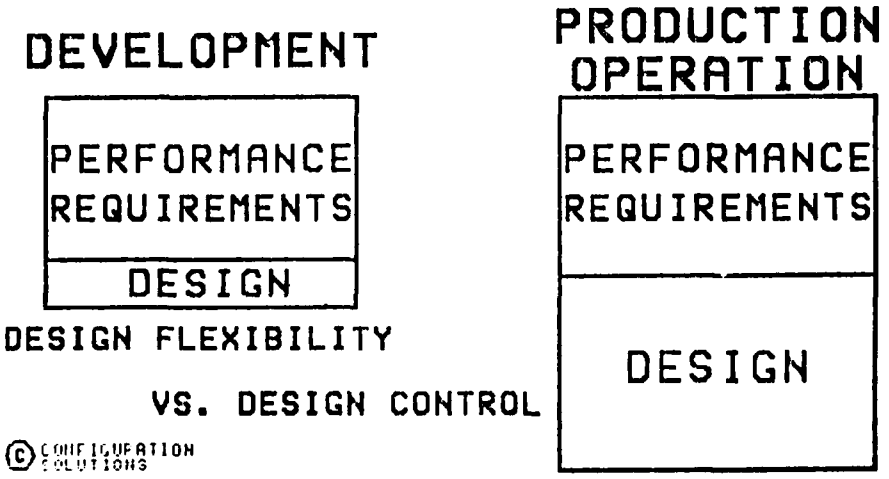
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FUNCTIONAL



WHEN TO CONTROL



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CONFIGURATION MANAGEMENT
ENGINEERING MANAGEMENT PRACTICES

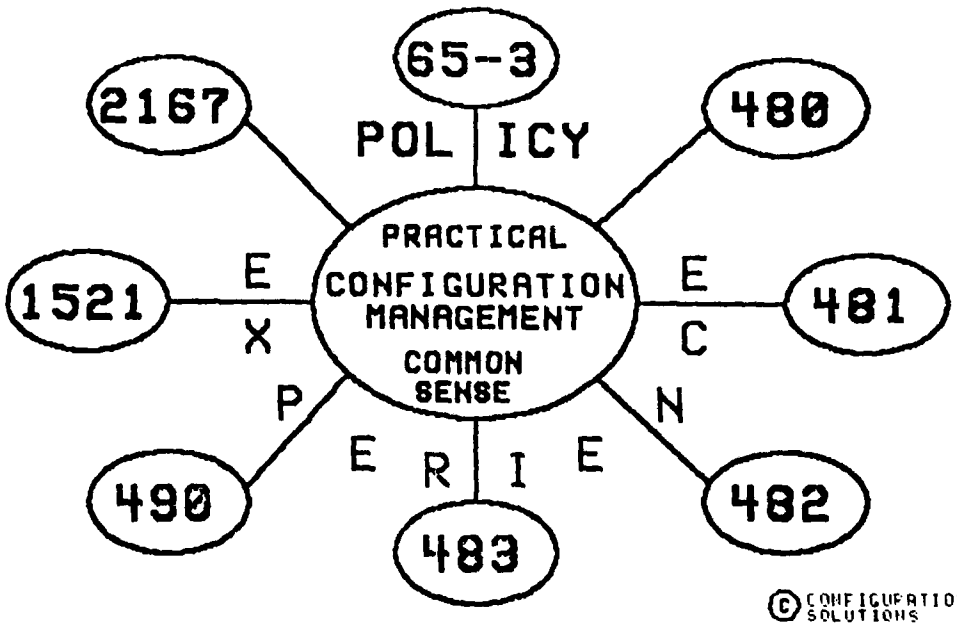
IDENTIFICATION=DOCUMENTATION
- -PERFORMANCE REQUIREMENTS
- -OPERATIONAL DESIGN

AUDITS=VERIFICATION
- -PERFORMANCE MET
- -DESIGN DOCUMENTED

CONTROL=COMMUNICATION
- -SYSTEM ENGINEER ALL CHANGES
- -COMPLETE IMPACT DESCRIBED

ACCOUNTING=TRACEABILITY
- -DOCUMENTATION - ISSUE THRU CURRENT
- -UNITS - DELIVERY THRU CURRENT

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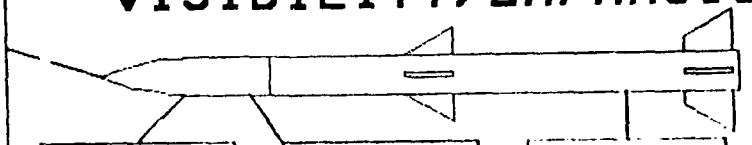


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CONFIGURATION ITEMS (CIs)

MISSILE CI DEVELOPMENT SPEC
- -MISSILE
- -GUIDANCE
- -SOFTWARE
- -ROCKET MOTOR

CRITICAL ELEMENTS VISIBILITY/EMPHASIS



GUIDANCE CI DEVELOPMENT SPEC

SOFTWARE CI DEVELOPMENT SPEC

ROCKET MOTOR CI DEVELOPMENT SPEC

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CONFIGURATION IDENTIFICATION

CUSTOMER NEEDS DEFINED
ENGRG GENERATES DOCUMENTATION
GOVT PROGRESSIVELY CONTROLS
- -FUNCTIONAL - SYSTEM RQTS
- -ALLOCATED - CI RQTS
- -PRODUCT - CI DESIGN

BASELINE <--- HOMEWORK
- -READY FOR NEXT PHASE
- -CONGRESSIONALLY DIRECTED

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DESIGN REVIEWS

REVIEW EVOLVING DESIGN

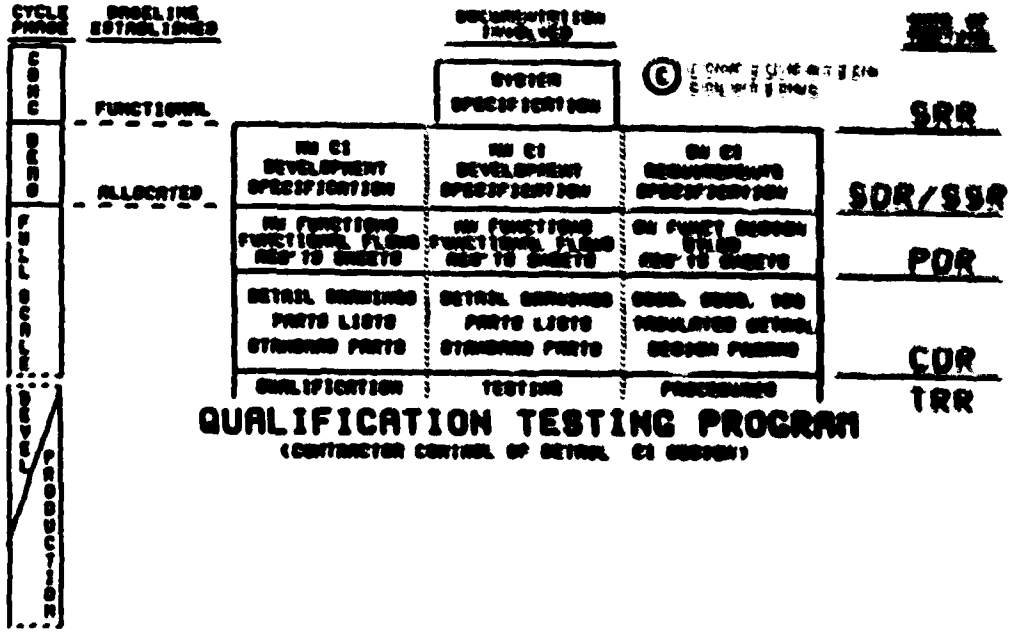
PERFORMANCE RQTS IN SPECS

- -SYSTEM REQUIREMENTS REVIEW (SRR)
- -SYSTEM DESIGN REVIEW (SDR)
- -SOFTWARE SPECIFICATION REVIEW (SSR)

DESIGN AGAINST BASELINE RQTS

- -PRELIMINARY DESIGN REVIEW (PDR)
- -CRITICAL DESIGN REVIEW (CDR)
- -TEST READINESS REVIEW (TRR) (SW ONLY)

RESPONSIBILITY OF ENGINEERS



CONFIGURATION AUDITS

VERIFY DESIGN SUITABILITY

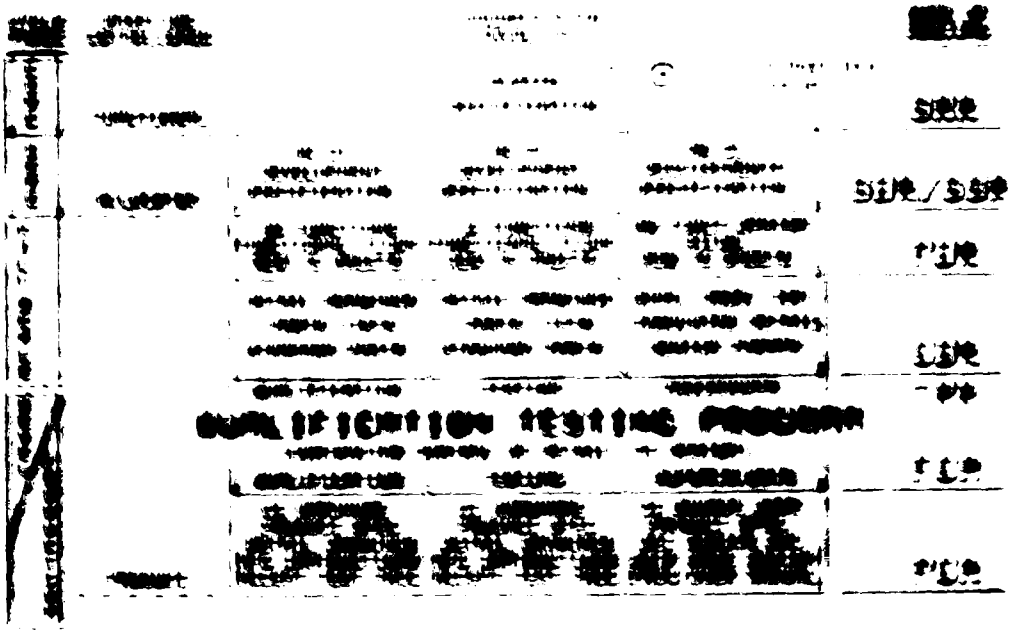
BASELINE PERFORMANCE ACHIEVED

- [illegible]
- [illegible]

PRODUCTION DESIGN DOCUMENTED

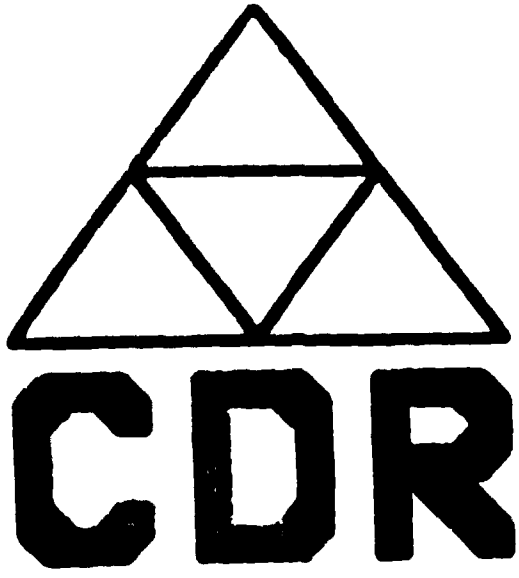
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CONFIG MGT RESPONSIBILITY

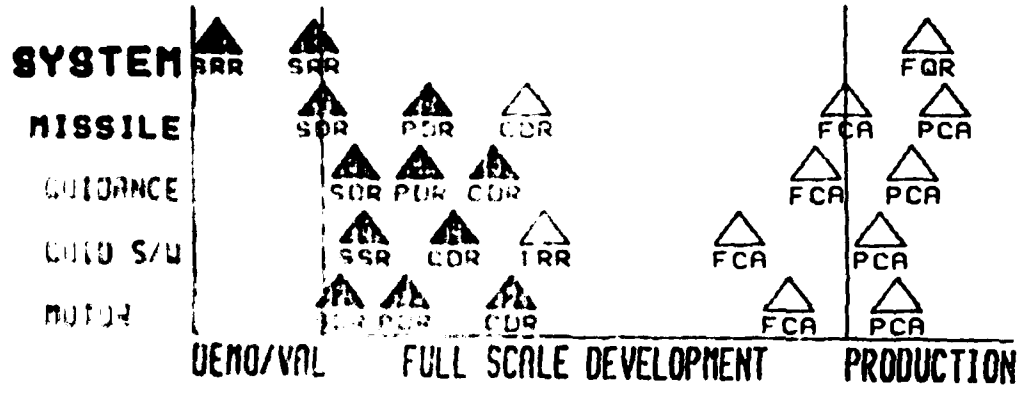


WHEN IS YOUR CDR SCHEDULED?





MISSILE SYSTEM REVIEW/AUDIT SCHEDULE



©

CONFIGURATION CONTROL

ENGINEERING CHANGE PROPOSALS
- -PERMANENT BASELINE CHANGE
- -NEW CONFIGURATION PREFERRED

DEVIATIONS/WAIVERS
- -TEMPORARY BASELINE CHANGE
- -DOCUMENTED CONFIGURATION PREFERRED

CHANGE CONTROL

CONTRACT CHANGE PROPOSALS
- -NO BASELINE IMPACT, JUST CONTRACT SCOPE

ADVANCED CHANGE/STUDY NOTICE
- -PRELIMINARY LOOK AT CHANGE IDEAS

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COMPARISON OF CHANGE CONTENT

ECP TO FUNCTIONAL/ ALLOCATED BASELINES

BASELINE CHGS
CONTRACT WORK SCOPE CHANGES
REVISED/ADD'L DATA REQTS
COST/SCHEDULE

COMPARISON OF CHANGE CONTENT

ECP TO FUNCTIONAL/ ALLOCATED BASELINES

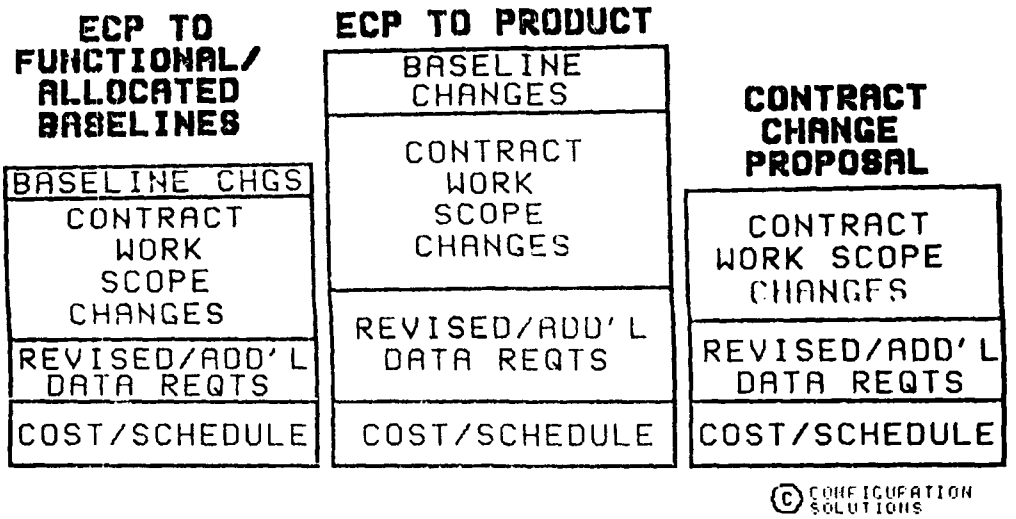
BASELINE CHGS
CONTRACT WORK SCOPE CHANGES
REVISED/ADD'L DATA REQTS
COST/SCHEDULE

ECP TO PRODUCT

BASELINE CHANGES
CONTRACT WORK SCOPE CHANGES
REVISED/ADD'L DATA REQTS
COST/SCHEDULE

© CMS ICUS ATION SYSTEMS

COMPARISON OF CHANGE CONTENT



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CHANGE MANAGEMENT PHILOSOPHY

ALL INFORMATION PROVIDED
ALL FUNCTIONS HAVE REVIEWED
ALL CONCERNS ADDRESSED
DECISION MAKER INFORMED

DELIBERATE, INFORMED DECISIONS

STATUS ACCOUNTING POLICY

IDENTIFY DOCUMENTS AND ITEMS
- -BASELINES (SPECS, DRAWINGS, LISTINGS)
- -IDENTIFICATION NUMBERS, SERIAL NUMBERS

IDENTIFY CONTRACT INFORMATION
- -CONTRACT NO., CONTRACTOR'S FSCM

TRACK PROPOSAL PROCSSING
- -MANAGE PROCESSING EVENTS

TRACK APPROVED CHANGES
- -RECORD OF CHANGE EFFECTIVITIES
- -IMPLEMENTATION STATUS

TRACK OPERATIONAL CONFIGURATION
- -MAINTENANCE, RETROFIT/MODIFICATION

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STATUS ACCOUNTING POLICY

BASELINE/CHANGE TRACEABILITY
- - ACCURATE, CURRENT INFORMATION
- - COMPLETE HISTORICAL INFORMATION

MANAGEMENT INFORMATION SYSTEM
- - FLEXIBLE REQUIREMENTS
- - TAILOR TO PROGRAM SIZE/NEEDS
- - CONTRACTOR'S EXISTING SYSTEM PREFERRED

STANDARDIZE DATA ELEMENTS
- - USE MIL-STD-482 DATA ELEMENTS
- - PROVIDE GUIDE TO DATA ELEMENTS

© CONFIGURATION SOLUTIONS

CONFIGURATION MANAGEMENT
ENGINEERING MANAGEMENT PRACTICES

IDENTIFICATION=DOCUMENTATION
- -PERFORMANCE REQUIREMENTS
- -OPERATIONAL DESIGN

AUDITS=VERIFICATION
- -PERFORMANCE MET
- -DESIGN DOCUMENTED

CONTROL=COMMUNICATION
- -SYSTEM ENGINEER ALL CHANGES
- -COMPLETE IMPACT DESCRIBED

ACCOUNTING=TRACEABILITY
- -DOCUMENTATION - ISSUE THRU CURRENT
- -UNITS - DELIVERY THRU CURRENT

© CONFIGURATION SOLUTIONS

DUPLICATE VIEWGRAPH

CYCLE PHASE	BASELINE ESTABLISHED	DOCUMENTATION INVOLVED			NAME OF MEETING
CONC	FUNCTIONAL		SYSTEM SPECIFICATION	© CONFIGURATION SOLUTIONS	SRR
DEMO	ALLOCATED	HW CI DEVELOPMENT SPECIFICATION	HW CI DEVELOPMENT SPECIFICATION	SW CI REQUIREMENTS SPECIFICATION	SDR/SSR
FULL SCALE		HW FUNCTIONS FUNCTIONAL FLOWS REQ'TS SHEETS	HW FUNCTIONS FUNCTIONAL FLOWS REQ'TS SHEETS	SW FUNCT DESIGN STLDD REQ'TS SHEETS	PDR
		DETAIL DRAWINGS PARTS LISTS STANDARD PARTS	DETAIL DRAWINGS PARTS LISTS STANDARD PARTS	SDDD, DBDD, IDD TABULATED DETAIL DESIGN PARAMS	CDR
		QUALIFICATION	TESTING	PROCEDURES	TRR
DEVEL/PRODUCTION		QUALIFICATION TESTING PROGRAM (CONTRACTOR CONTROL OF DETAIL CI DESIGN)			
		QUALIFICATION	TESTING	REPORTS/DATA	FCA
	PRODUCT	CI HARDWARE PRODUCT SPEC DETAIL DRAWINGS MFG INSTRUCTIONS ACCEPT TEST PROC	CI HARDWARE PRODUCT SPEC DETAIL DRAWINGS MFG INSTRUCTIONS ACCEPT TEST PROC	CI SOURCE CODE PRODUCT SPEC DET DESIGN DOC DATA BASE DESIGN PROG/USER MANUAL	PCA

LESSON 12

LESSON TITLE: **Data Management**

TIME: 1 hr

LESSON OBJECTIVE: The objective of this lesson is for each student to know the basic vocabulary of data management and the process for identifying contract data requirements.

SAMPLES OF BEHAVIOR: Each student will be able to:

a. Define the following terms:
   (1) Data
   (2) Data Item Description (*DID*)
   (3) Standard Data Item Description
   (4) Onetime Data Item Description
   (5) Acquisition Management System and Data Requirements Control List (*AMSDL*)
   (6) Contract Data Requirements List (*CDRL*).

b. Describe the Data Call and Data Requirements Review Board (*DRRB*) process which is used to identify the data requirements for a specific contract.

c. Describe the role of the Data Management Officer both in identifying data requirements and in managing the delivery of data once it is placed on contract.

TOPIC INTRODUCTION:

Now that we have addressed how we (1) analyze each technological alternative or weapon system, (2) plan for supporting these alternatives, and (3) track these technological characteristics and changes to the critical items in the weapon system, it is easy to see why a program manager's job is never done -- there is so much information to sift through before a decision can be made. There are many documents that are generated that contain information necessary to the government in monitoring the status of a program. This data is managed according to policy identified in Department of Defense Instruction 5010.12, *The Management of Technical Data.* Without a comprehensive data management system, there would be inefficiencies in the acquisition system, with unnecessary duplication, insufficient types, and untimely receipt of data submissions. This lesson introduces the basic terminology used in data management, and the tools available to get data on contract, so that procurement of data is managed efficiently and effectively. Also, some of the data activities that typically occur in the system program office are addressed, in tailoring the data requirements to your program.

METHOD OF INSTRUCTION: Lecture/Discussion

INSTRUCTIONAL MATERIALS:

a. Article: *An Overview of Data Management*, by Mr Sam Epstein, AFIT/LSY

b. Article: *Reducing the Cost of Data Acquisition*, by Mr Beck, Program Manager, Jan/Feb 1985

c. *Data Management* videotape

d. Lesson viewgraphs

AUDIO-VISUAL AIDS: Chalkboard

INSTRUCTIONAL EQUIPMENT: Video monitor and 3/4" tape player

REFERENCES:

a. DODI 5010.12, *Management of Technical Data*

b. DOD 5010.12-L, *Acquisition Management Systems and Data Requirements Control List (AMSDL)*

c. DOD STD-963, *Data Item Descriptions (DID) Preparation of*

d. AFR 310-1, *Management of Contractor Data*

e. AFSCR 310-1, *Management of Contractor Data*

f. AFLCR 310-1, *Management of Contractor Data*

REQUIRED STUDENT PREPARATION:

a. Read article: *An Overview of Data Management*

b. Read article: *Reducing the Cost of Data Acquisition*

c. Scan lesson viewgraphs

DISCUSSION QUESTIONS:

A brand new Program Manager (*PM*) for a non-major program is in the middle of leading his very inexperienced technical team in writing a Statement of Work (*SOW*). The following conditions are given:

a. All technical members are unfamiliar with sound data management principles for identifying and ordering contractually acquired, weapon system acquisition data. (They have not yet had SYS 100, nor are they expected to be Data Managers).

b. They have just been informed by the Contracting Officer that much of the information (i.e. data) they need from the contractor for their management and oversight of the contract must be ordered formally and handled contractually via a DD Form 1423, *Contract Data Requirements List* (*CDRL*). This data is primarily related to various SOW tasks.

c. They have been told there is a person called a Data Manager (*DM*), with whom they must deal, in getting out a Data Call Letter and in running a Data Requirements Review Board (*DRRB*). The outcome of this DRRB will be the CDRL for the Request for Proposal (*RFP*).

1. List some major planning actions you would provide the PM to help him efficiently do his mission of writing SOW tasks which might be linked for formal Data Deliverables.

2. Discuss how you would structure the Data Call Letter and who you would recommend to chair the DRRB?

Consider best utilization of the Data Manager who has access to such DM tools as the Acquisition Management Systems and Data Requirements Control List (*AMSDL*), Data Item Descriptions (*DIDs*), and AFR 310-1, *Management of Contractor Data*, which explains how to complete a DD Form 1423, CDRL.

BOTTOM LINE: The Program Manager can chair the DRRB or delegate this to the Data Manager. What would you do? In all cases the Data Manager should do the Data Call Letter.

3. Describe how the Data Management Officer (*DMO*) identifies data requirements in managing the delivery of data?

[Acronyms introduced in this lesson, and their description]

Chapter 12

AMSDL	**Acquisition Management Systems & Data Requirements Control List**
DAL	**Data Accession List**
DDMO	**Defense Data Management Office**
DIDs	**Data Item Description(s)**
DMO	**Data Management Officer**
DRRB	**Data Requirements Review Board**
EDMO	**Engineering Data Management Officer**

AN OVERVIEW OF DATA MANAGEMENT

SECTION I -- INTRODUCTION

Data is defined (by AFR 310-1) as *recorded information, regardless of form or characteristic*. It includes all the administrative, management, financial, scientific, engineering, and logistics information and documentation which is required for delivery from the contractors. It can be thought of as being either technical or nontechnical in nature. DOD Standard 963, *Preparation of DIDs* distinguishes technical data as Type I and nontechnical data as Type II. Type III data is one-time use data and can be either technical or nontechnical. The overall guidance for data is found in DODD 5010.12 and DOD 5010.12-M. Data is acquired for two primary purposes:

(1) *information feedback from the contractor for program management, control, and decision making; and*

(2) *information needed to manage, operate and support the system, such as specifications, technical manuals and engineering drawings.*

Data management is the function that governs and controls the selection, generation, preparation, acquisition, and use of data from contractors. The rest of this paper will address the general terminology used in data management, the process used to identify data requirements, and some selected topics related to data management.

SECTION II -- TERMINOLOGY

Acquisition Management Systems and Data Requirements Control List (*AMSDL*, DOD 5010.12-L) -- An index which identifies acquisition management systems, source documents, and Data Item Descriptions (*DIDs*) which have application. A Defense Data Management Office (*DDMO*) controls the AMSDL and the processing for approval of data item descriptions included in it. DDMO must process requests for new standard data items to the Office of Management and Budget (*OMB*). An approved data item is given an OMB control number, with an expiration date, as required by the Paperwork Reduction Act (Public Law 96-511).

Data Item Description (*DID*). A completed form (DD Form 1664) that defines the data content, preparation instructions, format and intended use and recommended distribution of data that might be required of a contractor. The DID might be viewed as a specification for data to be generated and delivered as a result of a DOD contract. There are three types of data item descriptions:

(1) *Standard data item description.* A data item that has been approved for general use, listed in the AMSDL, and published and distributed to the military services, federal agencies, and to subscribing DOD contractors by the Naval Publications and Forms Center in Philadelphia, Pennsylvania.

(2) *Tailored data item description.* A standard data item that exceeds the requirement for information and must be tailored downward, or diminished, to meet the specific requirement. Tailoring may only be accomplished to:

(a) clarify or adjust content to meet program data requirements within the intent and scope of the DID.

(b) accept contractor's format.

(c) reduce the scope through deletion of words, paragraphs, or sections.

(3) *One-time data item description.* A data item that is developed when a data requirement cannot be met by use of, or by tailoring of, a standard data item, or by combining submittals of multiple tailored standard data items. A one-time DID will have a six month timeframe to be put on a contract. Once on contract, it is valid for the life of that contract. It will be assigned an OT DID number from an approved block of OT numbers which (as of this writing) is typically controlled by data management focal points at product divisions.

NOTE: One-time DIDs are not listed in the AMSDL, nor are they printed and distributed to the field. The contract they are part of is the only place they occur and the DD Form 1664, detailing the one-time DID, is incorporated in its entirety into that particular contract.

Because of the limited use, a one-time DID should be used only to meet the needs of the contract for which it was developed. If future uses are anticipated, the one-time DID should be forwarded, through data management channels, to DDMO for consideration by OMB for approval as a new standard DID.

Contact Data Requirements List (*CDRL*) -- A list of data requirements that is authorized for a specific procurement and is made a part of the contract. This list is comprised of a series of DD Forms 1423 (individual CDRL forms) which contain the DID identification numbers and delivery instructions. The CDRL is one of the two places in the contract that can establish a requirement for the contractor to deliver data. The other area is by specific contract clauses, formerly called the general provisions section, which brings in Federal Acquisition Clauses applicable to your contract. Both the CDRL and the clauses require OMB Control over the data being collected, as regulated by the Paperwork Reduction Act (Public Law 96-511):

(1) CDRL data may best be thought of as data directly linked to Statement Of Work (*SOW*) tasks and is managed by the Data Management Officer (*DMO*). (Detailed instructions for completing the DD Form 1423, Contract Data Requirements List are found in AFR 310-1).

(2) Data required by FAR clauses most often deals with the *sound business* aspects of contracting and is managed by the Contracting Officer.

SECTION III -- THE PROCESS

The Program Manager is responsible for acquiring the contract data necessary to manage all aspects of the program/project. A Data Management Officer (*DMO*) is usually appointed to assist the Program Manager in this task. The process of identifying and acquiring the required data begins in the Concept Exploration Phase and continues throughout the entire system life cycle. For each contract to be issued (usually for each phase of the program), the formal process begins when the DMO issues a data call. This data call is usually a letter which describes the planned program and asks functional managers to identify and justify their data requirements for that contract. The Air Force uses a special data ordering form to order data, in responding to the data call. The form is the AF Form 585, *Contractor Data Requirement Substantiation*, explained in AFR 310-1, which is a mirror image of the DD Form 1423; it also contains blocks to justify the need for the data ordered, show impact for not ordering the data and, provide

the name, phone number and office symbol of the individual ordering the data. The data call is sent, not only to the different functional offices within the program office but, also, to all participating commands and agencies.

All of the functional managers identify their information needs on the AF Form 585 and use the AMSDL to identify standard data item descriptions that may meet their requirements. They should then review the DIDs to assure that they provide the needed data. They would then tailor the data item descriptions to eliminate unnecessary requirements. This tailoring process is not unlike special-ordering a new car. The DID is similar to the dealer's catalog. You need to clarify some options by identifying the specific exterior and interior colors. In other cases, you have redundant options (such as tire types and sizes), and you identify which one you want. In many cases, there are options you don't want, and so you tell the salesperson you don't want them. In this way, you arrive at the car you want without paying the cost of options that you don't want.

If they cannot identify a standard data item description, or tailor a standard data item description to meet their requirements, they would generate a one-time data item description on a DD Form 1664, using the guidance in DOD Standard 963, ***Preparation of DIDs***. Their requirements are sent to the DMO, usually on AF Forms 585. This form identifies the required data item description, delivery instructions, and provides the justification for the acquisition of the data item.

The DMO compiles all the requirements and attempts to eliminate redundant data items. The next step is for the Program Manager to review the requirements and the associated justification. The review is usually done in a meeting called a Data Requirements Review Board (*DRRB*). This board is normally comprised of representatives from the functional areas having significant data requirements. The board does not vote; rather, they recommend. The Chairperson of the DRRB makes the final decision. (The Program Manager may chair the DRRB, or delegate this role to the Data Management Officer). Based on this meeting, the Program Manager will decide which data items will be included in the Request for Proposal, going out for the contractors to respond to, in their proposals.

Some DMOs are called in to provide technical evaluations to the negotiating team commenting on the contractor's proposed data preparation and pricing effort. The DMO, in conjunction with the contracting office, will then finalize the desired Contract Data Requirements List (*CDRL*), negotiate it with the contractor, and make it a part of the contract.

After contract award, the DMO is responsible to track, for timely delivery, all of the CDRL data on the contract. If the contractor is late on delivery or if the data delivered is deficient (including having restrictive markings not authorized by the contract), the DMO, through the Contracting Officer, can use the FAR clause entitled, ***Technical Data -- Withholding of Payment,*** to withhold from the contractor up to ten percent of the contract price in order to press for the late/deficient data. If the Government is late on granting approvals to the contractor, on any data submitted requiring Government approval, the DMO aids the Program Manager in speeding up the Government approval process, to reduce Government-caused contract schedule slippages.

SECTION IV -- SELECTED TOPICS

Deferred types of data:

(a) Deferred Ordering. This is explained in the Federal Acquisition Regulation (*FAR*), Part 27, which deals with the Acquisition of Technical Data and Computer Software. These types of data are expensive to prepare, in the required form, and updating and maintaining these are costly. Examples of such data would be engineering drawings, computer software, and technical manuals. Deferred Ordering of Data is applied contractually, via a FAR clause, and provides for the delaying of the ordering of technical data generated in performing the contract until a need for the data can be established, and the data requirements can be specifically identified, for delivery under the contract. The typical situation, where deferred ordering would apply, is an undefined design where one is "pushing the state of the art." The data which has been deferred is later defined, the actual order for the data is placed contractually, and delivery is scheduled. Then, the only charges for this data should be for the collection, formatting and printing/ electronic transmitting and computer tape copying. The charges for all engineering efforts should have previously been charged against the statement of work tasks as opposed to data preparation expense. There is a three year rule built into the FAR Deferred Ordering Clause which sets the limitation on when deferred ordering can occur.

(b) Deferred Delivery. This is also explained in FAR, and is applied contractually, via a FAR Clause. Deferred delivery refers to those situations where receipt of the technical data or computer software, by the Government, would be premature for adequate storing and handling. The typical situation, where deferred delivery would apply: Government inability to store/update/retrieve data. As with deferred ordering, deferred delivery data should only include the cost to collect, format, print or make a tape. There is a two year rule built into the FAR Deferred Delivery Clause which sets the limitation on when deferred delivery can occur.

(c) Deferred Requisitioning. This is also done contractually; however, there are no FAR Clauses to apply. Instead, the Contracting Officer writes special custom language in a clause which is developed to describe the instant contracting situation. Now the terms, prices, and delivery schedule can be established up front; however, the data would arrive later. There are no year rules; however, the Contracting Officer could negotiate a timeframe, to fit the situation. Typical situations where deferred requisitioning would apply include lack of final design, hardware undeployed, and Government inability in-house to manage the data. The advantages of deferred requisitioning are the Government does not store, update, or retrieve the evolving design related data. The contractor does this and will charge for this additional service. (None of these deferred data techniques are without additional cost).

(d) Data Accession List (*DAL*). This technique employs a DID for the listing of non-CDRL data which evolves over the life of the contract. The contractor will create a library of all this non-CDRL. The DID only gets the list of what is in the *library*. The Government buying office can order data deliverables from this list. There is no approval of any item from the list, nor is there any say on format or content. The Government is charged for copying costs and for the storing and retrieving from the contractor's data *library*. There is obviously some additional cost, to set up a DAL mechanism on a contract, but it is another way to have access to practically all the remaining data.

[illegible]

Requirements Data

[illegible]

(a) [illegible]

1) [illegible]

2) [illegible]

(b) [illegible]

1) [illegible]

2) [illegible]

(c) [illegible]

1) [illegible]

2) [illegible]

(d) [illegible]

1) [illegible]

2) [illegible]

3) [illegible]

4) [illegible]

(e) [illegible]

1) [illegible]

(f) [illegible]

1) [illegible]

Current Issues in Requirements Area

The primary [illegible] in the Department of Defense (DoD) [illegible] the lack of a growing necessity for all the services. The Air Force has [illegible] with several existing [illegible] visible representations [illegible] Management should be aware that the Air Force has designated a new position of Engineering Data Management Officer (EDMO) as a specialist [illegible] Management in acquiring visible representations [illegible] The EDMO will be working [illegible] at all Air Force Systems Commands [illegible] Air Force Logistics Command (AFLC) [illegible] The AF EDMO will be involved in the whole engineering [illegible] with [illegible] plans in the preparation of engineering drawings and engineering data packages, and will coordinate with the AFLC EDMO [illegible] at the level AFLC for the system.

Final Comments

Attachments 1 and 2 [illegible] provide charts showing the old and new (88) numbering schemes. Both schemes are now in existence; however, as old [illegible] are revised for continuation in the AFSCM, they will be given new [illegible]

[redacted]

[redacted]

[redacted]

SOLD	Soldering
STDZ	Standardization
TCSP	Technical Support
TCTS	Federal Communications Systems Technical Standards
THDS	Screw Threads
THRM	Thermal Joining of Metals
TMSS	Technical Material Specifications & Standards

Attachment 2: Key to DIC Numbering Sequences
Before 1 July 1985
1 Letter
Up to 20,000 Numbers

DLIS LOOK UP DATA ITEMS

[illegible] IDENTIFIER

[illegible]	ARMY
[illegible]	NAVY
[illegible]	AIR FORCE
[illegible]	DEFENSE LOGISTICS AGENCY
[illegible]	MARINE CORPS
[illegible]	NATIONAL SECURITY AGENCY
[illegible]	DCAA (COMPTROLLER)
[illegible]	OASD (S&MS)
[illegible]	DEFENSE COMMUNICATIONS AGENCY
[illegible]	DoD COORDINATED
[illegible]	27969 VARIOUS NAVY ACTIVITIES
[illegible]	[illegible] AIR FORCE

[illegible]

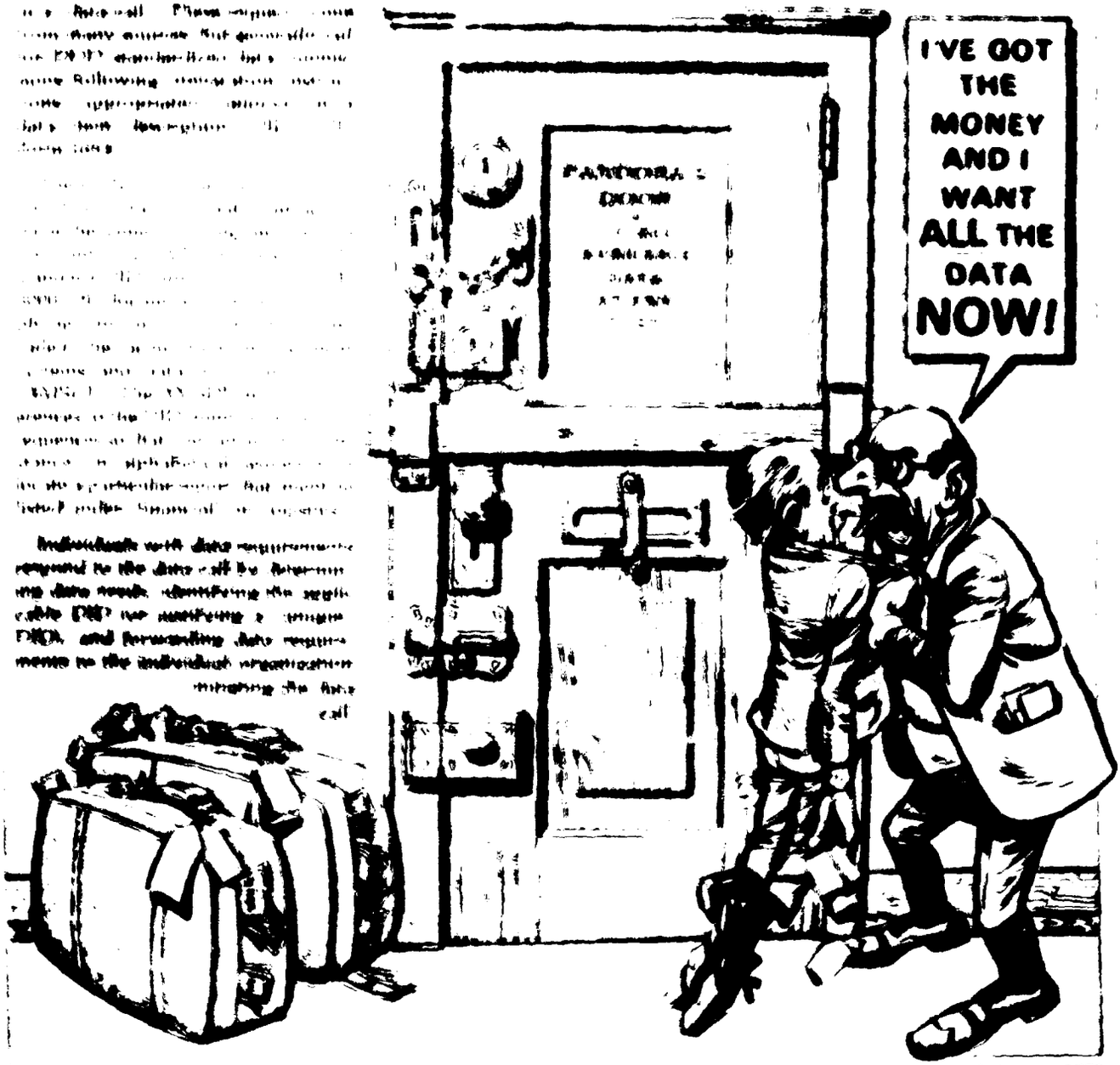
FUNCTIONAL CATEGORIES

A	[illegible]
E	ENGINEERING [illegible] MANAGEMENT
F	FINANCE
H	HEADQUARTERS
I	INVENTORY SUPPORT
N	NON-TECHNICAL PUBLICATIONS
P	PROCUREMENT PRODUCTION
R	RELATED DESIGN PROCUREMENTS
S	SYSTEM SUBSYSTEM ANALYSIS
T	TEST
V	PROVISIONING

[illegible] Range *

BUYING DATA

Reducing the Cost of Data Acquisition



Data "Wish List"

Various responses to the data call may be redundant or seemingly excessive. A review process by a Data Requirements Review Board (required for major programs) must scrub down the data "wish list" to that which is necessary and cost-effective for the government.

Often individuals requesting data may not realize their cost or be in a position to do a cost-benefit tradeoff. Sometimes that information can be gained from potential contractors through responses to draft solicitations that ask for comments on excessive data requirements or areas where unique or format data would suffice.

After reviewers agree on essential data, the final CDRL must be cross-checked against the proposed contract statement of work to ensure that cited references are correct. Then these documents, plus the cost of the purchase request package, are sent to enable the contracting officer to assemble a solicitation. Although preparing a CDRL is normally a function of the requiring office rather than the contracting office, some teamwork in preparation can help to determine when and how data are most cost-effectively obtained. In some cases, the contracting officer may help [illegible] contract requirements, allowing for later delivery of data or for specific events, special requirements, or even data pricing where pre-pricing would be impracticable. Where technologies are involved, there may be a need for careful consideration of possible proprietary rights, ownership of data by contractors, and therefore a need to evaluate the situation and select the best course of action.

DD Form 1423

The DD Form 1423 is the key contracting data delivery document. The requirement is legal, and this form is mandatory. In many cases you may be cutting off [illegible] data. The contracting officer leaves the choice from including pricing and [illegible] in the original contract bid. Contractors are cautioned to price in all data cost only those costs associated with producing the actual data and the costs of those work on which the data depend. However, government requirements for data items often have stringent specifications that can make a simple request – like a copy of an engineering drawing – seem very expensive because the contractor must convert from contractor format drawings to government format drawings.



To reduce data costs, consider using contractor-format data. The data information on the side of the DD Form 1423 is one key to identifying where much of the data cost is in the contracting effort. A careful pre-negotiation review by someone with authority to request authority to use data-preparation requirements can save considerable money while providing necessary information.

Another cost-saver on DD Form 1423 is the distribution block. Do 40 offices *really* need voluminous data?

The acceptance code also can drive costs. Data may be delivered with a simple letter of transmittal, or may require a formal DD Form 250 acceptance and payment document. Critically important data should have careful inspection and formal acceptance, but requiring a formal DD 250 on a routine report is overkill.

Formally delivered data may be separately priced with payment to the contractor after each accepted data submittal, or may be priced-in with other contract line items (or combinations thereof). Pricing associated data with basic contract-line items saves extra administrative effort in separately pricing and paying for the data. On the other hand, data that represent a significant contractor effort may deserve to be paid on delivery. Of course, you don't want to pay for the manual now, get the system months later, and then find the manual is inadequate. Likewise, you don't want the system delivered now with no manual until later, which leaves you with no choice but (sole source) contractor maintenance. Careful management is necessary, in coordination with maintenance training and other logistics-support people, to ensure that necessary data are available at the right time.

Delivering Data

When should data be delivered? Your contracting officer can provide *some flexibility* on data-delivery dates to help get the latest and best data when needed. Delivery can be tied to contractual events; i.e., manuals for maintenance 60 days before scheduled government testing (to permit government training time that may need its own contract).

By using a "deferred delivery" clause, the contract can call for certain data items to be delivered within a set time after notice from the contracting officer. This technique has been useful for items such as engineering drawings, for which you want to wait to get the latest possible version in case there are changes.

Where more data may be desired later, but you don't know exactly how much or what they should cost (perhaps items are not yet designed when the contract is priced), a deferred-ordering clause can list data items for later ordering (pricing/negotiating). Later in the program when specific requirements are known, those items may be ordered. This technique can be used for buying

● *Mr. Reck is a Professor of Acquisition Management at DSMC.*

reprocurement data. Early in a program, you would not want to buy all possible drawings if only a few were needed for reprocurement purposes. The deferred-ordering clause permits later identification of exactly which parts are identified for reprocurement, and then permits buying drawings for those items. Buying reprocurement data this way can be a difficult sole-source negotiation. One cost and administrative effort solution to prevent later difficult negotiations is to consider prepricing a fixed price for each size reprocurement drawing. Thus, each "A" size (regular page) drawing would be a certain price, and so on up for drawings through the large "E" drawing, which would be more expensive. Then, when it is time to order reprocurement drawings, the pricing would consist of extending the prices per size by the number of drawings of that size.

Getting the right data requirements on contract require management's attention. A good data manager can help save costs and help a program run smoother by putting an aggressive effort on data review, tailoring requirements, and ensuring accurate preparation of the CDRL and any special contract requirements.

Reducing Data Cost

The first and best place to try to get a handle on data costs is at the data call. The tone of the call letter or communication will tell people whether to open their AMSDL (DOD 5000.19L) and order all data items in their field *like a shopper with a free* credit card, or whether to consider carefully exactly what data are needed - and why. Responses to the data call may reveal redundancy where several users could agree to use the information from one report rather than different reports. Looking at the DID preparation instructions may reveal numerous opportunities to cut out unnecessary detail, or encourage alternative contractor format data so that the contractor doesn't have to reprogram its computer, or change its internal procedure just to transmit data in government format.

References on the DID are provided to other applicable MILSPECS or STDS. Often, several documents will refer also to other references - this is called "tiering" and may be very costly if requirements are not tailored.

In January 1984, the Deputy Secretary of Defense designated OUSDRE(AM&P) as the focal point for a test program to eliminate non-cost-effective contract requirements. Under this DOD initiative, the services selected major programs to review aggressively and reduce unnecessary data and specification requirements. Policy is thus changing on data requirements toward justifying inclusion, rather than ordering whenever in doubt. To communicate the new policy and provide useful "how to" hints and guidance for limiting data requirements, DOD has drafted a handbook (2483) for program managment use.



There are difficult judgment areas regarding how much data to order at the start of a program. We need to consider and tailor requirements carefully to specific needs, using functional requirements and contractor-format data where applicable. With more communication about the problem, and less *how to*, we release the creative ingenuity of industry unhampered by unnecessary requirements.

Do We Need Data For Competitive Reprocurement?

Some people argue that DOD should acquire all data that might be needed for possible maintenance support. Some general contract language is set up to do this. Contractors are asked to propose prices that cover all data needed for operation and maintenance of the system. Thus, the price offered to the government will normally include the price of unlimited data rights to permit operation and maintenance. Nobody knows the cost of this policy. Many assume savings of future competition may repay the initial acquisition expense of proprietary data, but this is not necessarily so.

Let's assume you are buying a (low-volume) system that uses a commercial, high technology state-of-the-art component like a new computer. In simple terms, let's assume you are buying a vehicle—a small truck that will be modified to carry a military item. Assume the manufacturer has a "black box" computer managing the engine spark, fuel injection, and other functions. If this proprietary technology is a key to its competitive business, would the contractor even offer its latest technology system to DOD if we insisted on unlimited data rights? Perhaps not! Perhaps we would get a less-reliable old carburetor if we insisted on data. Or, perhaps, our $5,000 basic chassis and engine would be offered at $5 million, which might be a fair and competitive price for the technological secret.

What does this mean? *We need common sense in our data acquisition policy.* We need to consider cost versus benefit to make intelligent decisions about what data we really need. If a limited-quantity system has one proprietary IBM computer, it might be cost-effective to hire IBM for repair beyond the capability of the military technicians (if even necessary), rather than to consider buying the proprietary data to allow competing the computer maintenance to another firm.

Predetermination of Rights

It is far better to resolve who will own rights to data before contracts are awarded than it is to argue later. The contracting officer can insert a clause in the request for proposals,

which essentially says the government will receive unlimited rights in all but certain areas. Then, the contractor's response simply lists areas that it feels are proprietary; this becomes a basis for negotiated agreement in the contract to specify what (if any) data may be delivered with less-than-unlimited rights. Clarifying data rights before award by predetermination can preclude later problems.

Data Management

After contract award, data begin to flow in as required by the CDRL. Careful planning before award, and management after award can ensure data are received as needed and when needed. In addition to the special techniques for deferred delivery, deferred ordering, or milestones related delivery, data managers should establish a solid management suspense system to ensure data are received on time, and that any necessary action is complete.

Simple receipt of a data package does not mean it is adequate. Time must be alloted for review, government comments if necessary and possible resubmission with corrections. Where instructions are vague, or a contractor has less than top-quality people preparing data, the government data manager can anticipate need for corrections and resubmissions. Sometimes, government reviewers are too critical and the contractor expects its first submissions to be routinely rejected with lengthy comments. This can degenerate into a game where the contractor puts minimal effort into initial submissions and letters so that the government reviewer must be the proofreader and editor. This wastes time and money, so the program manager will want to take preventive action.

Getting Good First Submission

Government management's interest and contractor management's interest determine the quality and timeliness of data submissions. Where no one cares or mentions data requirements, you may expect less effort and, perhaps, poorly prepared or late work. Contractor interest is the secret for getting good data on time. This interest may be automatic due to company pride or a sense of responsibility. But, it can be stimulated before the due date via monthly review or follow-up questions by the government program manager. Quality of data submissions is a subjective area that may be effectively improved by an award-fee provision.

Timely Response to Data Submissions

If comments need to be made to data submissions, consider and establish reasonable times for action. Many contracts require contractor response to government comments within a number of days (30, 45, 60) for resubmission; therefore, similar time limits should be placed on government personnel for government action. It is interesting to see the impact on the government bureaucracy if your contractor has a clause saying "lack of response by the government within 45 days shall be deemed government approval."

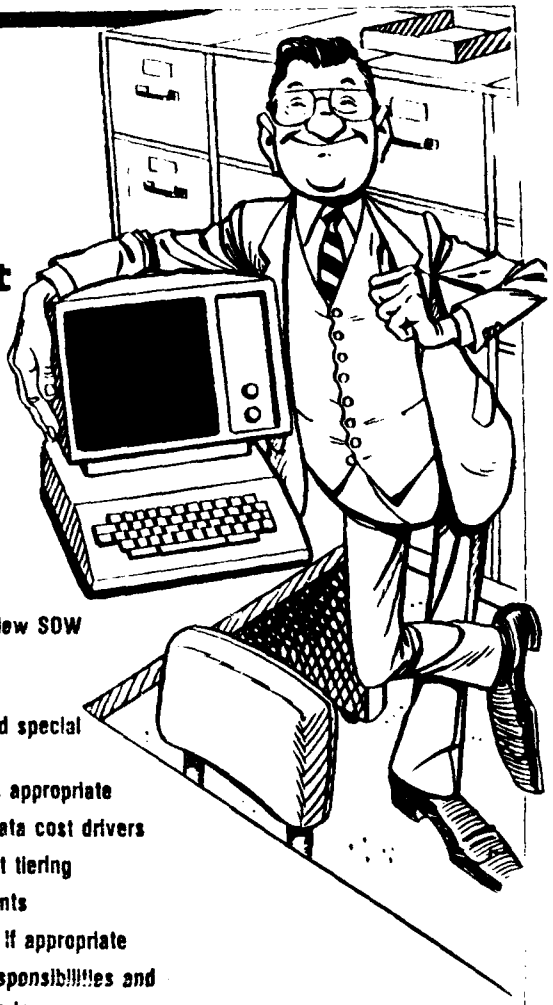
The Bottom-Line

How we approach data acquisition drives overall program costs and potential success. Basic information above provides a general framework of considerations for management improvement.

The data checklist (Chart 1) shows only big-picture reminders, each of which needs careful consideration, sound planning, and aggressive implementation to gain success. The bottom-line is reduced data cost *while still obtaining essential information*. Exactly how much data are essential is the subjective management judgment of which is worth buying.

The fiscal imperative must become "order only if absolutely needed" rather than "order in case someone might need it."■

Your Very Own "Handy-Dandy" Data Checklist



- ☐ Data strategy discussions
- ☐ Data call emphasizing strategy
- ☐ Data review:
  - ☐ max tailoring
  - ☐ eliminate redundancy
  - ☐ to allow contractor format when possible
- ☐ Draft CDRL
- ☐ Draft SOW to match CDRL/Review SOW for cross-referencing to CDRL
- ☐ Consider data-rights questions
- ☐ Draft RFP with SOW, CDRL, and special requirements for industry
- ☐ Use predetermination clause as appropriate
- ☐ Review industry feedback on data cost drivers
- ☐ Tailor final requirements to limit tiering
- ☐ Coordinate final data requirements
- ☐ Include data in award-fee plan, if appropriate
- ☐ Designate data-management responsibilities and approach for post-award monitoring

SAM EPSTEIN
AFIT/LSY
JUNE 1987
A/V 785-3355

DEFENSE DATA MANAGEMENT

LESSON OUTLINE

DATA MANAGEMENT PROGRAM: OBJECTIVES, ENFORCEMENT, DEFINITIONS, DOD, USAF DATA MGMT ORGANIZATION

IMPACT OF PAPERWORK REDUCTION ACT: TIGHTER RULES ON COLLECTING DATA

IMPACT OF 1984 DEFENSE AUTHORIZATION ACT: CONTROLLED DISTRIBUTION OF TECHNICAL DATA

DATA MANAGER'S TOOLS OF THE TRADE: AMSDL, DISs, CONTRACT FORMS

FLOW PROCESS OF IDENTIFYING DATA: DATA CALL, DATA REQUIREMENTS REVIEW BOARD

PROGRAM ENFORCEMENT

DATA DEFINED AS * * * *RECORDED INFORMATION*, REGARDLESS OF FORM OR CHARACTERISTICS.

* CONTRACTORS CONTRACTUALLY REQUIRED TO DELIVER DATA: UNDER GUIDELINES OF PAPERWORK REDUCTION ACT

** SOW LINKED DATA: VIA DATA ITEMS (DIDs)

LISTED ON DD FORM 1423, CONTRACT DATA REQUIREMENTS LIST (CDRL)

** CONTRACT FAR CLAUSE DATA (NO DIDS)

DATA MANAGEMENT PROGRAM OBJECTIVES

* ACQUIRE: *MINIMUM* *ESSENTIAL* *DATA*

*ASSURE DATA ITEMS ARE SELECTED FROM THE AMSDL

OR

AUTHORIZED AS ONE-TIME DATA

* ACQUIRE DATA IN CONTRACTOR FORMAT, WHEN PRACTICAL

* ASSESS DATA CONTINUALLY THROUGHOUT PROGRAM LIFE

REORGANIZATION OF DATA MANAGEMENT WITHIN DOD

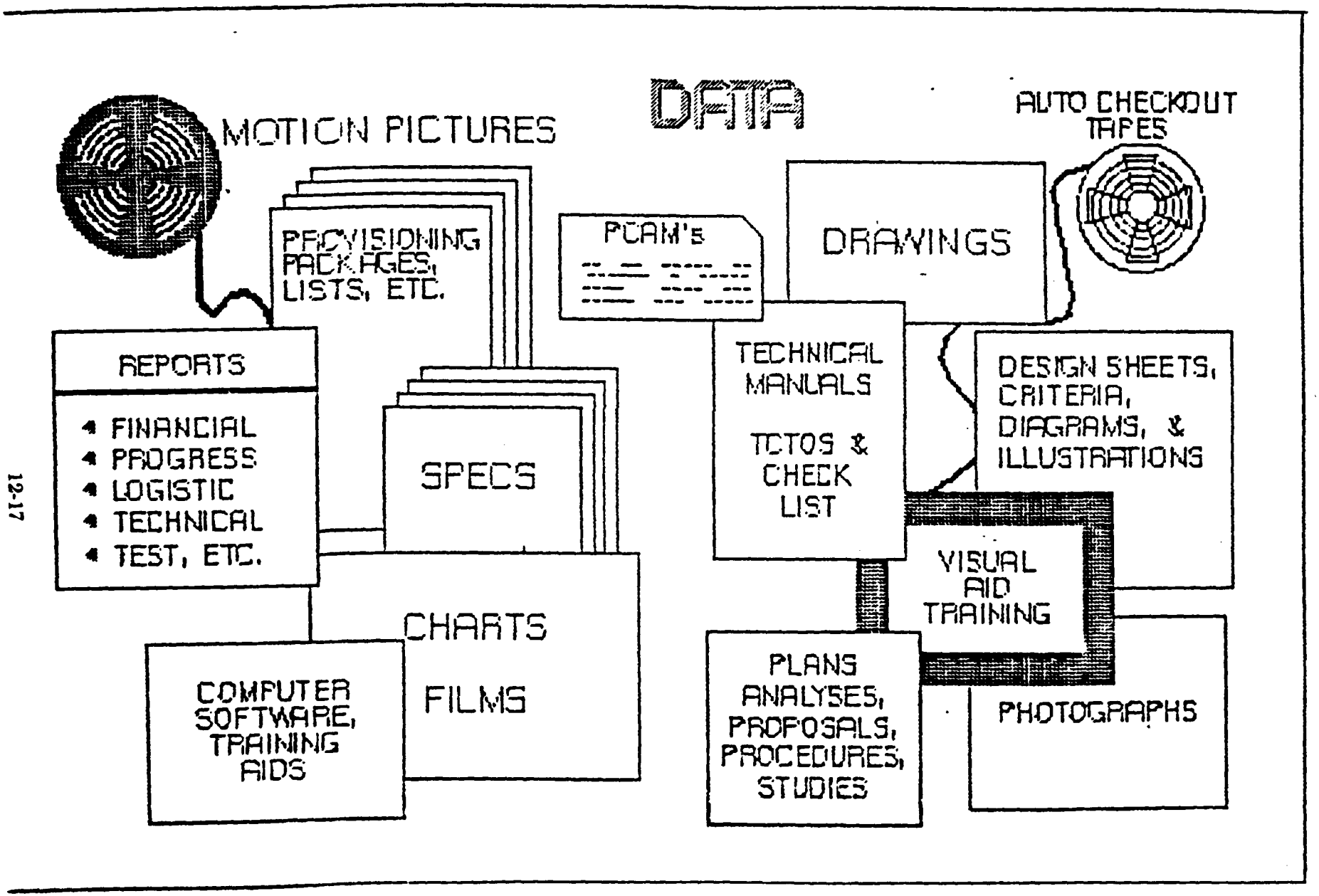
EFFECTIVE 23 MAR 86

OASD (A&L) SDM

STANDARDIZATION & DATA MANAGEMENT OFFICE*

DSPO DEFENSE STANDARDIZATION PROGRAM OFFICE	DDMO DEFENSE DATA MANAGEMENT OFFICE	DPSO DEFENSE PRODUCT STANDARDS OFFICE

* FORMERLY: DMSSO DEFENSE MATERIEL SPECIFICATIONS & STANDARDS OFFICE


DATA
MOTION PICTURES
AUTO CHECKOUT TAPES
PROVISIONING PACKAGES, LISTS, ETC.
PCAM's
DRAWINGS
REPORTS
FINANCIAL
PROGRESS
LOGISTIC
TECHNICAL
TEST, ETC.
SPECS
TECHNICAL MANUALS
TCTOS & CHECK LIST
DESIGN SHEETS, CRITERIA, DIAGRAMS, & ILLUSTRATIONS
VISUAL AID TRAINING
CHARTS
FILMS
COMPUTER SOFTWARE, TRAINING AIDS
PLANS ANALYSES, PROPOSALS, PROCEDURES, STUDIES
PHOTOGRAPHS

US AIR FORCE DATA MANAGEMENT

HQ USAF/RDXM	HQ USAF/LEYE
HQ AFSC/SD	HQ AFALC/SE
PRODUCT DIVISIONS	AIR LOGISTICS CENTERS

PAPERWORK REDUCTION ACT OF 1980

PUBLIC LAW 96-511

* IMPACT OF PL 96-511 ON CONTRACTOR DATA SUBMITTALS

** ONLY *AUTHORIZED* DATA AS PUBLISHED IN THE AMSDL OR THE FAR IS LEGALLY REQUIRED TO BE FORMALLY SUBMITTED TO THE GOVERNMENT

** ANOTHER MECHANISM OF AUTHORIZED DATA IS A ONE-TIME DID PUBLISHED IN ONE DOD CONTRACT FOR USE ONLY IN THAT CONTRACT WHICH HAS BEEN ASSIGNED AN OMB CONTROL NUMBER

** AUTHORIZED DATA MEANS THE DATA REQUEST DOCUMENT

AS WRITTEN

OR

AS TAILORED *DOWN*

SUMMARY: IMPACT OF PL 96-511

NOW *BY LAW*: *CONTRACTORS* ARE *NOT REQUIRED TO PROVIDE ANY CDRL DATA* AS A FORMAL SUBMITTAL WHICH IS ILLEGALLY *TAILORED*
i.e., it is really requesting information which is

ABOVE & BEYOND
THE PUBLISHED, OFFICIAL *DATA ITEM DESCRIPTION*

MAJOR CULPRIT: IMPROPER TAILORING (i.e., *UPWARD*) IN THE REMARKS BLOCK OF THE CDRL WHICH *CALLS OUT* THE DID

THE *NEW* NATIONAL ASSET: AMERICAN UNCLASSIFIED TECHNICAL INFORMATION HAVING MILITARY OR SPACE APPLICATION

INCREASED PROTECTION PROVIDED BY THE 1984 DEFENSE AUTHORIZATION ACT AND

DODD 5230.24 *Distribution Statements on Technical Documents*

DODD 5230.25 *Withholding of Unclassified Technical Data from Public Disclosure*

IMPLEMENTED IN CONTRACTS BY ORDERING MARKING OF DATA WITH DISTRIBUTION STATEMENTS WRITTEN ON ALL TECHNICAL DATA SUBMITTED

(BLOCKS 8 & 16, DD FORM 1423, CAN CITE OR REQUIRE DETERMINATION OF DISTRIBUTION STATEMENT)

Distribution Statement A:	Unlimited Distribution
Distribution Statement B:	U.S. Government Agencies Only
Distribution Statement C:	U.S. Government Agencies and their Contractors
Distribution Statement D:	DOD and DOD Contractors
Distribution Statement E:	DOD ONLY
Distribution Statement F:	Distribution as directed by DOD Controlling Office
Distribution Statement X:	U.S. Government Agencies and Private Individual Enterprises eligible to obtain export controlled technical data IAW 10 U.S.C 140c.

DATA MANAGER'S *TOOLS OF THE TRADE*

* AMSDL: Acquisition Management Systems and Data Requirements Control List (Now the DOD 5010.12-L) (formerly was the DOD 5000.19-L)

Listing of all approved Standard DIDs

* DID: Data Item Description (DD Form 1664)

Individual Description of One Collection of Recorded Information

Standard DID: Scientific/Technical (TYPE I)
or
Mgmt/Administrative (TYPE II)

Note: Office of Management & Budget (OMB) considers a DID a *Rules Document* which must have an OMB Control Number and Expiration Date Signifying if has been *Approved* by OMB per the Paperwork Reduction Act: PL 96-511

DOD 5010.12-L

OMB CONTROL NO.: 0704-0188
EXDATE: 6/30/86

NOTICE READ INTRODUCTORY MATERIAL PRIOR TO USING THIS AMSDL

AMSDL

ACQUISITION MANAGEMENT SYSTEMS AND DATA REQUIREMENTS CONTROL LIST

DEPARTMENT OF DEFENSE

1 APRIL 1988

SUPERSEDES DOD 5000.19-L VOL II, ACQUISITION MANAGEMENT SYSTEMS AND DATA REQUIREMENTS CONTROL LIST, DATED 1 OCTOBER 1986

The AMSDL is a Cross-Referenced LIST of Data Item Descriptions (DIDs) & Those Specifications & Standards Requiring Deliverable Data

PART I: LISTS SOURCE DOCUMENTS (MILITARY SPECS & STDS)

PART II: LISTS DIDs NUMERICALLY

PART III: LISTS DIDs BY KEYWORDS IN THE DID TITLE ONLY

PART IV: LISTS CANCELLED /SUPERCEDED SOURCE DOCS & DIDs

Attachments 3 and 4 provide a sample DD Form 1423 and AI Form 365

Attachment 1: Key to DID Numbering Sequences
After 1 July 1985
4 Letters
80,000 Numbers

'NEW LOOK' DATA ITEMS

DI-MISC-80000A

38 Data Functional Area Assignments

ADMN	Administrative Data
ATTS	Automatic Test Technology Standards
CDNC	Computer Aided Design Numerical Control
CMAN	Configuration Management
CMPS	Computer Technology *
DCTS	Data Communications and Processing Standards
DRPR	Drawing Practices
EDRS	DOD Engineering Data Requirements Standards
EGDS	Engineering Data Systems
EMCS	Electromagnetic Compatibility
ENVR	Environmental Requirements and Related Test Methods
FACR	Facility Construction Design Requirements
FNCL	Financial Data
FORG	Forgings
GDRQ	General Design Requirements
HFAC	Human Factors
ILSS	Integrated Logistics Support Standards
IPSC	Information Processing Standards for Computers
MCCR	Mission Critical Computer Resources
MECA	Metal Castings
MFFP	Metal Finishes & Finishing Processes & Procedures
MGMT	Management Data
MISC	Miscellaneous
MNTY	Maintainability
NDTI	Non-destructive Testing and Inspection
NUOR	Nuclear Ordnance
PACK	Packing, Packaging, Preservation & Transportability
QCIC	Quality Control Assurance and Inspection
RELI	Reliability
SAFT	Safety
SLHC	Long Haul Communications
SOLD	Soldering
STDZ	Standardization
TCSP	Technical Support
TCTS	Tactical Communications Systems Technical Standards
THDS	Screw Threads
THJM	Thermal Joining of Metals
TMSS	Technical Manual Specifications & Standards

Attachment 2: Key to DID Numbering Sequences
Before 1 July 1985
1 Letter
Up to 99,999 Numbers

'OLD LOOK' DATA ITEMS

AGENCY SERVICE IDENTIFIER

10000 - ARMY
20000 - NAVY
30000 - AIR FORCE
40000 - DEFENSE LOGISTICS AGENCY
45000 - MARINE CORPS
50000 - NATIONAL SECURITY AGENCY
60000 - OASD (COMPTROLLER)
61000 - OASD (SP&IS)
65000 - DEFENSE COMMUNICATIONS AGENCY
70000 - DOD COORDINATED
[illegible] - [illegible] VARIOUS NAVY ACTIVITIES
[illegible] - [illegible] AIR FORCE

[illegible]

FUNCTIONAL CATEGORIES

A - ADMINISTRATIVE
E - ENGINEERING & CONFIGURATION MANAGEMENT
F - FINANCIAL
H - HUMAN FACTORS
L - LOGISTICS SUPPORT
M - TECHNICAL PUBLICATIONS
P - PROCUREMENT PRODUCTION
R - RELATED DESIGN REQUIREMENTS
S - SYSTEM SUBSYSTEM ANALYSES
T - TEST
V - PROVISIONING

recent change *

DATA ITEM DESCRIPTION	Form Approved OMB No. 0704-0188 Exp. Date: June 30, 1986
1. TITLE ENGINEERING SUPPORT DATA (ESD)	2. IDENTIFICATION NUMBER DI-ATTS-80285

3. DESCRIPTION/PURPOSE

3.1 Engineering Support Data (ESD) consists of text, schematics, assembly drawings, program listings and computer-generated outputs, functional flow diagrams, test strategy reports, and any relevant information to provide the life cycle support of the TPS.

3.2 The purpose of the ESD is to provide all documentation essential to a full comprehension of the intent, design, structure and interrelation of all elements of the TPS.

4. APPROVAL DATE (YYMMDD)	5. OFFICE OF PRIMARY RESPONSIBILITY (OPR)	6a. DTIC REQUIRED 6b. GIDEP REQUIRED
870115	AS	

7. APPLICATION/INTERRELATIONSHIP

7.1 This Data Item Description (DID) contains the format and content preparation instructions for that data generated by 5.4 of MIL-STD-2077A(NAVY).

7.2 This DID is related to DI-ATTS-80284, Test Program Set Document (TPSD).

7.3 This DID supersedes DI-T-21554A, DDI-T-21361A, DI-T-21553A, and DDI-T-21359A.

7.4 When both this DID and DI-ATTS-80284are cited on the DD Form 1423, this DID or DI-ATTS-80284must be tailored in Block 16 of the DD Form 1423 to "DELETE" duplicate data elements.

8. APPROVAL LIMITATION	9a. APPLICABLE FORMS	9b. AMSC NUMBER
		N4029

10. PREPARATION INSTRUCTIONS

10.1 Source Document. The applicable issue of the documents cited herein, including their approval dates and dates of any applicable amendments and revisions, shall be as reflected in the contract.

10.2 Contents. Engineering Support Data (ESD) shall consist of the following elements, as required, depending on the test requirements for the UUT, the capability of the ATE, and the requirements of the work authorization document or contract.

a. Reference Documents
b. Test Strategy Report (TSR)
c. Test Program Listing
d. Functional Flow Chart (FFC)
e. Diagnostic Flow Chart (DFC)
f. Test Diagrams (TDMs)
g. ATG Support Data
h. Computer Program Aids Documentation
i. Reproducible Copy of TPI Master
j. Unique Parts Specification
k. ID Data Package

DATA MANAGER'S *FORMS*

* CDRL: Contract Data Requirements List (DD FORM 1423)

Contract Document which *calls out* specific DIDs
by Title and DID Number

and

links the DID to the SOW

SOW ↔ CDRL ↔ DID

It also prescribes such parameters as delivery schedule, approvals, quality checks (DD Form 250), proof of submittal (letter of transmittal), distribution statement and

DOWNWARD TAILORING OF THE DID /T
(AFR 310-1 tells how to complete a DD Form 1423)

CDRS: Contractor Data Requirement Substantiation (AF FORM 3613)

Air Force unique form
Look Alike to the CDRL which asks and has
blocks to answer *questions*:

WHY do you need this DID?

and

What Impact if the DID is not ordered?

SAMPLE OF AN AUTOMATED DD FORM 1423

CONTRACT DATA REQUIREMENTS LIST

ATCH NR: _A__ TO EXHIBIT: ____ SYSTEM ITEM: XYZ RADIO

TO CONTRACT/PR: F33657-87-C-XXXX CATEGORY: ____ LIST: _____ CONTRACTOR: ACME ELECTRONICS

1)	2) Engineering Support Data (ESD)	8) APP. CD	10)	11)	14)
A001	3)				AFIT/LSY 1/1
4)	5)	7)	9)	12)	13)
DI-ATTS-80285	SOW PARA 6.1	15	D		

16)

BLK 8: Distribution Statement D, Distribution to DOD and DOD Contractors only

15) TOTAL

PREPARED BY	DATE	APPROVED BY	DATE

DD FORM 1423 (X) ADPE Adaptation Nov 86 (AFIT/LSY) Page ___ of ___ Page:
OMB CONTROL NO.: 0704-0188

FOR SCHOOL USE ONLY

12-26

CONTRACTOR DATA REQUIREMENTS JUSTIFICATION

I. IDENTIFICATION

CONTRACT/PR NUMBER | SYSTEM/ITEM

II. DD FORM 1423 ENTRIES

1. SEQUENCE NO.	2. TITLE OR DESCRIPTION OF DATA / 3. SUBTITLE	6. TECHNICAL OFFICE	10. FREQUENCY	12. DATE OF 1ST SUBMISSION	14. DISTRIBUTION AND ADDRESSES (Addressee - Requirements codes)
Assigned by DMO	**	Functional Office OPR	*	*	OPR USERS *

4. AUTHORITY (Data Item Number)	5. CONTRACT REFERENCE	7. DD 250 REQ	8. APPR CODE	9. IN-PUT TO SAC	11. AS OF DATE	13. DATE OF SUBSEQUENT SUBMI/ EVENT IDENT	
**	SOW para, or Contract ref (Sec H)	*	*	*	*	*	*

16. REMARKS

*AFR 310-1, Management of Contractor Data
**DOD 5000.19-L, Vol II (AMSDL)

NOTE: Block 16 (Remarks) is used to explain tailored features of the DID, Items 1 through 15, and any resubmittal schedule or special conditions involving updating data submitted for government approval.

15. TOTAL

III. JUSTIFICATION/TAILORING/DISPOSITION

17. JUSTIFICATION: STATE HOW THE DATA WILL BE USED, WHO WILL USE IT, AND THE IMPACT IF IT IS NOT OBTAINED.

Fully justify need for data being requested. The following information shall be included:

1. The directives, management concepts, and functional disciplines which identify the need.
2. How data will be used.
3. Primary users of the data (organizations).
4. Need for multiple copies.
5. Impact if government does not have data approval rights (include an alternate approach).
6. If this data item is a one-time DID, attach a copy and provide a list of standard DIDs considered and why they can't be used.

SAMPLE

18. CHECK APPLICABLE BOX(ES)	YES	NO
CONTRACTOR FORMAT ACCEPTABLE		
DID REQUIREMENTS TAILORED		
DELIVERY CAN BE DEFERRED		

19. REQUESTER IDENTIFICATION

NAME

ORGANIZATION

PHONE

DATE

20. DATA REQUIREMENTS REVIEW BOARD DISPOSITION

☐ APPROVED ☐ DISAPPROVED ☐ OTHER

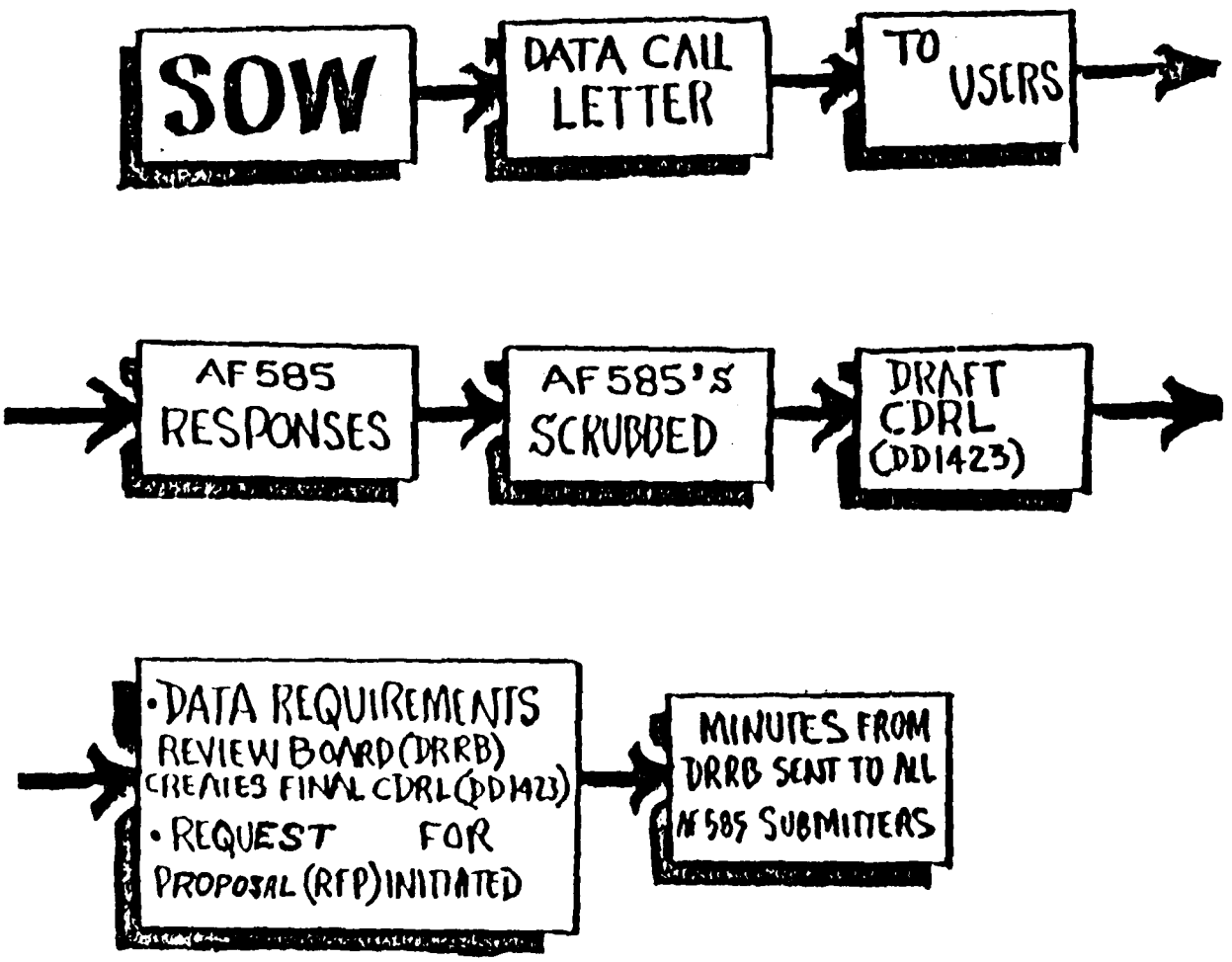
REMARKS

Completed by DRRB action

DATE | SIGNATURE

AF FORM 585

* U.S. Government Printing Office: 1986—720-079/40,000


SOW
DATA CALL LETTER
TO USERS
AF 585 RESPONSES
AF 585'S SCRUBBED
DRAFT CDRL (DD1423)
• DATA REQUIREMENTS REVIEW BOARD (DRRB) CREATES FINAL CDRL (DD1423)
• REQUEST FOR PROPOSAL (RFP) INITIATED
MINUTES FROM DRRB SENT TO ALL AF 585 SUBMITTERS

LESSON 13

LESSON TITLE: **Manufacturing Management**

TIME: 2 hrs

LESSON OBJECTIVE: The objective of this lesson is for each student to know the role and objectives of manufacturing management throughout the system acquisition process.

SAMPLES OF BEHAVIOR: Each student will be able to:

a. Define manufacturing and discuss the role of manufacturing management in DoD acquisition program.

b. Describe the manufacturing management activities during the Concept Exploration/Definition phase of a program.

c. Describe the manufacturing management activities during the Concept Demonstration and Validation phase of a program.

d. Describe the manufacturing management activities during the Full-Scale Development phase of a program.

e. Describe the manufacturing management activities during the Production phase of a program.

f. Describe the following manufacturing initiatives:
   (1) Industrial Modernization Incentive Program;
   (2) Work Measurement;
   (3) Transition from Development to Production.

TOPIC INTRODUCTION:

The topic of manufacturing management, which has been called production management, needs to be understood by most program managers. When your program starts ***ramping up*** for production, this is not, and should not be, the first time you have addressed manufacturing issues. Manufacturing management is a process that can start as early as the Concept Exploration/Definition phase and it continues throughout the acquisition life cycle. This lesson introduces these activities, how they might affect your program, and three unique manufacturing initiatives your program may be experiencing in the future.

METHOD OF INSTRUCTION: Lecture/Discussion

INSTRUCTIONAL MATERIALS:

a. Article: *Manufacturing Management in the Weapon System Acquisition Process*, by Maj Mike Farr, AFIT/LSY

b. *Manufacturing Management* videotapes

c. Lesson viewgraphs

AUDIO-VISUAL AIDS: Chalkboard

INSTRUCTIONAL EQUIPMENT: Video monitor and 3/4" tape player

REFERENCES:

a. AFR 800-9, *Production Management in the Acquisition Life Cycle*

b. DOD Directive 4245.6, *Defense Production Management*

c. DOD Directive 4245.7, *Transition from Development to Production*

d. DOD *Manufacturing Management Handbook for Program Managers*, Defense Systems Management college, July 1984

REQUIRED STUDENT PREPARATION:

a. Read article: *Manufacturing Management in the Weapon System Acquisition Process*

b. Scan lesson viewgraphs

DISCUSSION QUESTIONS:

1. What arguments would you use to persuade a program manager that early funding, during concept exploration/definition and concept demonstration/validation, of production-related tasks is vital to the success of the program?

2. Discuss the manufacturing activities occurring during each phase of the acquisition life cycle.

3. The manufacturing manager for a major program has suggested to the Program Manager (*PM*) that a feasibility assessment should be funded during concept exploration/definition and concept demonstration/ validation. The PM is reluctant because *we're not worried about production yet -- we won't get there for another 5 or 6 years.* What is the potential impact of failure to fund this activity?

4. What critical areas of interest should be examined during a Production Readiness Review (*PRR*)?

5. Why do contractors resist work measurement?

6. What is the significance of the "Hidden Factory"? What does it imply and what is the impact?

[Acronyms introduced in this lesson, and their description]

Chapter 13

FOT&E	Follow-On Operational Test and Evaluation
FSD	Full Scale Development
GFP	Government Furnished Property
IMIP	Industrial Modernization Incentive Program
PRR	Production Readiness Review(s)

MANUFACTURING MANAGEMENT

IN THE

WEAPON SYSTEM ACQUISITION PROCESS

INTRODUCTION

The term manufacturing, or production, has wide-ranging application anytime scarce resources are being transformed into goods and/or services. For our purposes, manufacturing is the transformation of raw materials into products needed to perform the DOD mission of national security. The resources required for this transformation process include people, equipment, money, material, facilities, manufacturing technology and processes, and time.

Management of the manufacturing process is a subset of the larger function of program management and represents the techniques of economically planning, organizing, directing, and controlling the resources needed for production. A primary goal of manufacturing management is to assist program managers in assuring that defense contractors deliver goods and services, of specified quality, on time, and within agreed cost constraints. To accomplish this goal, manufacturing managers must become involved EARLY in the acquisition life-cycle of a program.

This early involvement is crucial if the DOD expects acquisition programs to function smoothly during the production phase, where the largest portion of acquisition dollars is expended. Early involvement of the manufacturing function provides the opportunity to identify and reduce many of the major risks that have caused so many DOD programs to falter during the transition from development to production, experiencing instead substantial cost overruns, schedule delays, and performance compromises.

The remainder of this article addresses, first, some of the most important manufacturing activities that should occur during each phase of the acquisition process, and second, briefly describes several manufacturing-related initiatives that are affecting the management of DOD acquisition programs. The material on manufacturing activities is excerpted from the DOD *Manufacturing Management Handbook for Program Managers*, published by Defense Systems Management College.

MANUFACTURING ACTIVITIES DURING THE ACQUISITION PROCESS

I. CONCEPT EXPLORATION/DEFINITION PHASE:

A. Evaluate Production Feasibility

The program manager should ensure that a manufacturing feasibility assessment is accomplished in the initial phases of product development. The feasibility estimate determines the likelihood that a system design concept can be produced using existing manufacturing technology while simultaneously meeting quality, production rate and cost requirements.

The feasibility analysis involves the evaluation of:

1. Producibility of the potential design concepts.
2. Critical manufacturing processes and special tooling development which will be required.
3. Test and demonstration required for new materials.
4. Alternate design approaches within the individual concepts.
5. Anticipated manufacturing risks and potential cost and schedule impacts.

The feasibility assessment is accomplished to bound the manufacturing risks incurred in selecting a particular design, fabrication concept and material as the basis for moving into the demonstration and validation phase. Without this type of assessment, the program manager may find that later phases of the program cannot be accomplished within the defined thresholds as a result of incompatibilities between the system design and the manufacturing technology available to execute it.

B. Assess Production Risks

Based upon the feasibility assessment, the program office should develop a manufacturing risk evaluation to quantify the statement of manufacturing feasibility. Manufacturing risk assessment is a supporting tool for the contractor and program office decision making process. It seeks to estimate the probabilities of success or failure associated with the manufacturing alternatives available. These risk assessments may reflect alternative manufacturing approaches to a given design, or may be part of the evaluation of design alternatives, each of which has an associated manufacturing approach. It should also consider the sensitivity of the feasibility estimates to the assumptions which were made on those areas of the design for which specific design data was not available.

The quantified risk levels can then serve as the basis for the development of specific risk resolution approaches for the later phases of the acquisition cycle and can provide guidance to the budget estimation process. In programs where manufacturing risk has not been addressed during development phases, there have been problems during the production phase involving high cost, extensive design changes, unplanned material and process changes, and difficulties in delivering hardware on time which conforms to the contract requirements.

C. Identify Manufacturing Technology Needs

The evaluation of manufacturing capability is based on the analysis of the compatibility of the demands of the manufacturing task and the manufacturing facility and equipment required to accomplish it. Part of the result of the manufacturing feasibility evaluation is the identification of manufacturing technology needs. The needs are identified so that the kinds of manufacturing capabilities that will be required can be put on line in the factory prior to the production phase. When manufacturing technology development programs involve some risk, the program manager should consider requiring the design contractor to identify (or develop) fall-back positions for each of the risk areas and/or demonstrate the required capability in the laboratory or in pilot production.

D. Develop Manufacturing Strategy

Program manufacturing strategy is a subset of the overall acquisition strategy. Specific decisions need to be made concerning the level of competition that is to be attained during the production phase. If the program will be dual-sourced, the early

planning must take into account the strategy for acquiring the necessary data rights and for assuring that capable suppliers exist. New manufacturing technologies, if required by the system concept, will require specific plans for development, proof and transition of the technology to the eventual producer. This effort will necessitate close coordination with the Service manufacturing technology organization to assure compatibility of the technology development schedule with the system development schedule. Many studies have shown that competition makes a major contribution to reducing weapon system cost. If competition is to be effective, it must result from the application of a clearly defined strategy to ensure that an environment of true competition can be established and maintained.

II. CONCEPT DEMONSTRATION AND VALIDATION PHASE:

A. Reassess Production Feasibility

Production feasibility is the likelihood that a system design concept can be produced using existing production technology while simultaneously meeting quality, production rate and cost requirements. As a follow-on to the feasibility assessment accomplished during the concept exploration/definition phase, the program office should use the increasingly more complete description of the system to update the assessment. This may be done within the program office or by the prime contractor(s). As the system design concept and manufacturing approach are validated, and design decisions are made, the amount of flexibility on the choice of production technologies decreases. It is important for the program manager to ensure that design decisions reflect currently available production technology. Consideration of feasibility must occur in a bounded environment. The primary bounds are the existing state of production technology, the cost targets established for the system, and the production rate and schedule requirements.

Feasibility assessment is useful in supporting decisions concerning which of the competing system designs should be carried into Full-Scale Development (*FSD*). It is also used to determine which of the manufacturing processes should be proofed during FSD and the nature of the proofing required. The process of weapon system design is dynamic, and the search for the best solution often involves changes to the design concept which can impact the manufacturing processes to be used. Failure to assess feasibility at a number of points during the acquisition process can result in accepting changes to the design which are incompatible with the capability of the industrial base.

B. Accomplish Production Risk Resolution

Production risk resolution involves demonstrating the attainability of the levels of manufacturing capability required. During this phase, it is not necessary that all the details of the production processes be demonstrated. The areas that represent advances beyond the current capability should be demonstrated in environments which are somewhat representative of the production floor. The focus is on determining that there is a reasonable expectation that the manufacturing materials and processes which will be required can be obtained, or fabricated in sufficient quantity and quality, to meet the production phase requirements. Deferring risk resolution to a later phase incurs a concern that the design will have to go into production relying on the processes or materials which have relatively unpredictable processing time and cost. There is the possibility that compromising efforts to meet quality, cost, and schedule goals may adversely affect

technical performance of the end item.

C. Complete Manufacturing Technology Developments

For those technologies identified, during the concept exploration phase, as requiring development, laboratory demonstrations should be accomplished. As with the system development program, the manufacturing technology development often represents a phased approach to definition and demonstration. The technology developer should demonstrate that the required process or material capability is attainable under laboratory or controlled conditions and also describe the procedure by which the technology can be extended into the manufacturing shop environment. Since it is normally anticipated that critical processes will be demonstrated in the production environment during the full scale development phase, it is important that the laboratory (or controlled production) process capability be demonstrated during this phase. Failure to do so may increase the risk, during FSD, that the material or process may be found not to be a viable approach for meeting the weapon system design requirements.

D. Preliminary Producibility Planning

Producibility is a measure of the relative ease of producing a product or system. It is also an engineering function directed toward generating a design which is compatible with the manufacturing capability of the defense industrial base. Each competing design needs to be evaluated from a producibility standpoint. The producibility effort must take into account the quantity of units, or systems, to be produced and the rate at which they will be manufactured, since quantity and rate determine the magnitude of the potential manufacturing efficiencies to be gained, or problems to be avoided. Producibility evaluations will serve as a basis for estimating the likely manufacturing cost and assessing the level of manufacturing risk of the system. Results of these assessments will support the development of specific contractual provisions for the full-scale development phase. Specific requirements may be identified based upon the specific system designs, and the potential for manufacturing cost reduction, through an aggressive producibility program.

E. Develop Production Readiness Review Plan

One of the major program office tasks during the full-scale development phase is the Production Readiness Review (*PRR*). It is critical that the specific requirements for contractor planning and support to the PRR be included in the FSD contract. There is also a need to ensure that the necessary government evaluation skills are available during FSD. These needs can only be met if the major readiness issues are identified during the DEMVAL phase and the methods for evaluating readiness are clearly defined. The readiness issues must cover both the defense system design and the production planning required. Since many of these issues are normally evaluated as part of the continuing process of design and program reviews, the planning for PRR should clearly describe how the outputs and analyses of these reviews can be applied to the PRR tasks.

III FULL SCALE DEVELOPMENT PHASE:

A. Complete Manufacturing Plan

At the end of the FSD, all of the information necessary to accomplish the detailed manufacturing operations for the system should be available. This information should be described in a manufacturing plan covering the issues of manufacturing organization,

make or buy planning, subcontract management, resources and manufacturing capability, and the detailed fabrication and assembly planning. The plan should also describe the types of Government Furnished Property (*GFP*) required and the specific availability dates for it. The contractor management control system plans, including those for configuration management, the control of subcontractors, and manufacturing performance evaluation should be described in sufficient detail for the program office to determine their expected utility. The plan should also include consideration of the potential requirements for industrial preparedness, including surge capability during the production phase, and the post-production phase requirements for support of the system in combat situations. The development of this formal manufacturing plan contributes value to the program from two standpoints. The primary benefit accrues from the fact that the contractor has to crystallize the manufacturing planning to a point where it can be described in the detail required. The secondary benefit is the usability the plan provides to the program management office personnel. It serves as a basis for a structured review of the contractor approach, and the expected cost of the production phase effort, and for a full assessment of manufacturing risk. Where such a plan is not developed during the FSD phase, there is often unnecessarily high cost, and schedule turbulence at the front end of the production phase.

B. Accomplish Producibility Engineering and Production Planning

Producibility, as noted above, is a measure of the relative ease of producing a product or system. Producibility studies, and analyses of the alternatives, are conducted by the contractor with consideration of the impact on cost, schedule, technical, and support performance. Among the alternatives available, the most efficient manufacturing materials, methods, and processes should be selected. Early production planning, based on design and schedule requirements is essential, if production delivery schedules are to be fulfilled. Production planning must include identification of potential problems, with an assessment of the capability required to produce the item, and industry's current capability to manufacture the system as designed. Potential production problems that require further resolution by study or development must be identified and action for resolution initiated. The producibility engineering and planning effort also results in the definition and design of the special tooling and test equipment required to execute the production phase effort, as well as the preparation and release of the manufacturing data package, required for the start of manufacture.

There are a number of factors to be considered in ensuring the producibility of a design:

1. Liberal tolerances (dimensions, mechanical, electrical).
2. Use of materials that provide optimum machinability, formability and weldability.
3. Shapes and forms designed for castings, stampings, extrusions, etc. that provide maximum economy.
4. Inspection and test requirements that are the minimum needed to assure desired quality and maximum usage of available and standard inspection equipment.
5. Assembly by efficient, economical methods and procedures.
6. Minimized requirements for complex or expensive manufacturing tooling or special skills.

There should be evidence that the contractor has accomplished producibility analyses of various options for the manufacturing task. The FSD phase results in the system design for entering production. As the design evolves during FSD, its producibility should be subjected to regular review (normally as part of the design review process).

C. Develop Detailed Production Design

Prior to release of drawings to the manufacturing location, the detailed design drawings, bills of material, and product and process specifications must be completed. Further, it is essential that design reviews be conducted, to assure that the contractor is complying with the design requirements, and, meeting the cost/design goals. The final design definition is the result of the performance requirements, the outcomes of the testing accomplished, producibility studies and other design influences. The production phase effort requires that the design be specified to a very low level of detail, so that the required processes, and resources, can be identified and obtained.

D. Accomplish Production Readiness Review (*PRRs*)

The objective of a PRR is to verify that the production design planning, and associated preparations for a system, have progressed to the point where a production commitment can be made, without incurring unacceptable risks of breaching thresholds of schedule, performance, cost, or other established criteria (DODI 5000.38). PRRs should be conducted by the program manager, as a time-phased effort, that will span full-scale development and encompass the develop/producer and major subsystem suppliers. The PRR examines the developer's design from the standpoint of completeness and producibility. It examines the producer's production planning documentation, existing and planned facilities, tooling and test equipment, manufacturing methods and controls, material and manpower resources, production engineering, quality control and assurance provisions, production management organization, and controls over major subcontractors. The results of the PRR support the program manager's affirmative decision at the production decision point; i.e., that the system is ready for efficient and economical rate production.

IV. PRODUCTION AND DEPLOYMENT PHASE:

A. Execute Manufacturing Program

The primary function of the production phase is to complete the manufacture of the defense system within the established time and cost constraints. Normally, the production rate is structured to start slowly and build into a defined steady state rate. Much of the same type of evaluation of contractor planning for initiation of the production phase (generally through the PRR) needs to be focused on the contractor planning to increase to the defined rate. The program manager also needs to focus attention on the levels of engineering change activity. An excessive number of engineering changes can disrupt the structure of the manufacturing planning and result in high manufacturing costs. Also, attention needs to be given to ensuring that acceptance criteria for the product or system are clearly specified and that there is minimum use of waivers, deviations and Material Review Board actions during the acceptance process. The program office manufacturing personnel should participate in the Physical Configuration Audit (*PCA*) when the *as built* item is compared with the technical documentation. Upon satisfactory completion of the PCA, the primary acceptance criteria will be the physical and

test requirements listed in the technical documentation. The completion of the production phase normally involves a series of contract actions (associated with each production lot) which will need to be planned and completed to fill the system acquisition objective. For each of these contracts, a decision will need to be made on the contract type, the incentive structure, if any, the level of government control and the desired program visibility.

B. Maintain Production Surveillance

One of the primary program management tasks, during this phase, is to establish and maintain a system for accomplishing surveillance over the progress of the contractor performing the manufacturing tasks. Generally, the program manager will want to ensure that information is available, to measure contractor effectiveness from time, cost and technical achievement standpoints. The program manager must also choose between a formally structured, and contractually specified, management control system or a currently existing contractor system. When problems occur during the production phase, the management control system should provide timely information to the program manager in a format that will support decision making and action processes.

C. Implement Product Improvement

The Follow-On Operational Test and Evaluation (*FOT&E*), and the initial user feedback on the system, often identify areas where improvements can be made to the system to allow it to better meet the constantly changing operational environment. The challenges for the program manager involve the decisions on which of these improvements to make, and the method of incorporating them, on the production line. To minimize production cost, the number of engineering changes should be kept to a minimum; but, operational requirements often militate in favor of change. A program may also involve preplanned product improvement. If this acquisition strategy applies, when and how to incorporate such improvements must be resolved early in the program.

MANUFACTURING INITIATIVES

I. Industrial Modernization Incentive Program (*IMIP*)

IMIP received its initial impetus during the late 1970s. At that time there was significant national concern over the declining industrial base, especially in the defense sector. Classical forces of competition were insufficient to stimulate productivity-related investments. Further, DOD business arrangements did not always provide adequate incentives for productivity investments. In a search for ways to motivate contractors to improve their productivity, the Air Force developed *Tech Mod* (or technology modernization), and the army developed what it called *industrial productivity initiatives*.

In 1982, the term IMIP was coined in an attempt to combine these endeavors into an integrated DOD-level effort. A *test period* began during which waivers to acquisition regulations were considered, new and unique ways of contracting were developed, and new methods were established to derive incentives and share them with contractors. By 1985, DOD Directive 5000.44, and a DOD guide for the implementation of IMIP were under development. These documents established IMIP as a DOD program to systematically implement new technologies into the defense industry.

The definition of IMIP has two important characteristics. First, IMIP is a joint venture -- a cooperative effort between government and industry. Second, IMIP involves the negotiation of a business deal between partners whereby each partner contributes funds and assumes risks, but also shares benefits in a *win -- win* fashion.

IMIP has short term as well as long term objectives; short term objectives include increased product quality, reduced leadtimes and lower costs for our weapon systems. The long term objective is a strong, healthy industrial base that can meet surge and mobilization requirements, should a conflict or war arise.

IMIP programs are accomplished in three phases. Phase I begins with a ***Top down factory analysis***. This analysis evaluates the needs of the overall facility, locates bottlenecks, and identifies potential manufacturing technologies and modernization opportunities which apply to the type of work normally done at that factory.

Phase II develops the enabling technologies and work centers that are needed to take advantage of the opportunities identified during phase I. Prototypes are built, and their use is demonstrated, during a formal review attended by the government. Plans for implementing the new technologies onto the production floor are also accomplished.

Phase III implements the IMIP through contractor purchase and installation of capital equipment in the factory. Actual benefits are monitored. As they accrue, incentives flow to the contractor; savings flow to the government; and the new technology is made available for transfer to other interested defense contractors.

Funding of these endeavors is shared between the government and industry. For example, during fiscal years 1981 - 1987, $1.9 billion has been invested within Aeronautical Systems Division alone. Of that amount, private industry has invested about $1.5 billion, or roughly four times that which the government has invested. Validated savings thus far exceed a quarter of a billion dollars. However, most IMIP projects have not yet entered phase III. The projected savings over the next decade is about $5 billion, or over two and a half times the original investment.

While our experience is still somewhat limited, documented results of this program appear to promise a strong, positive impact on the industrial base.

II. WORK MEASUREMENT

In the early 1970s, MIL-STD-1567 was developed to provide a framework for disciplined work measurement systems on defense contracts. Faced with increasing costs, and decreasing buying power, the DOD hoped to take the guess-work out of estimating costs, and to actually reduce costs.

The following discussion highlights the essence of what work measurement is all about. First, it is a method for evaluating efficiency that determines the amount of time it ***should take*** to do a given job. This "should take" time is expressed by what is commonly known as a labor time standard. Next, the actual time needed to do the job is measured and compared to the standard. This comparison is normally expressed one of two ways: If standard hours are divided by the actual hours taken to do the job, the result is an efficiency rating. Within the defense industry, you are likely to hear reference to the other type of comparison, which simply inverts the equation, and calls the result a performance index or realization factor.

Our definition of work measurement is not complete until we have analyzed the results of the comparison between standard and actual performance. Whenever efficiency is low, or the performance index is high, we have what is known as variance. Since this information is collected at various levels in the work breakdown structure, it is possible to pinpoint areas in the factory where problems and inefficiencies may exist. Correction of these problems may involve training of workers, method improvements, revised layout of the facility, changes in management procedures, or changes to whatever else the source of the problem turns out to be.

As mentioned, a labor standard defines the amount of time that a given task *should take*. However, there are additional requirements that must be met if we are to have a standard that can be applied accurately and consistently. The following definition fully describes all the characteristics of a valid labor time standard:

> *A labor time standard defines the time it should take a normally skilled operator following a prescribed method working at a normal all-day level of effort, to complete a defined task with acceptable quality.*

Note that the term *all-day level of effort* implies something that we haven't mentioned yet. A standard time is composed of the sum of what is called the *normal time* needed to do a job, plus additional time for *allowances*. These allowances recognize three factors that [illegible] the need for personal time (to use the restroom, get coffee, etc.), fatigue [illegible] as the day wears on; and (3) minor, unavoidable delays that [illegible] control. Therefore, normal time, plus some percentage for allowances, equals standard time.

MIL-STD-1567A, [illegible] contractual document for implementing work measurement, recognizes two [illegible] standards, referred to as type I and type II. Type I standards are [illegible] recognized industrial engineering techniques such as time study, predetermined time systems, standard data, and work sampling. Each technique has specific strengths and applications.

Type II standards [illegible] estimates based on experience and historical projections. While less reliable, [illegible] are effective during the early phases of a program and when it would [illegible] to develop a type I standard for a complex, low-volume task.

DOD [illegible] benefits from work measurement programs: By knowing more accurately how long a task should take, it is possible to:

- *Improve cost estimates*
- *Improve the accuracy and credibility of DOD budget requests*
- *Improve scheduling and other manufacturing control activities*
- *Help to [illegible] of layout and material handling problems by providing accurate figures for [illegible] of equipment*

Through *variance analysis*, or the performance analysis referred to earlier, it is possible to:

- *Reduce costs*
- *Improve manufacturing methods and processes*
- *Reduce scrap and waste*
- *Evaluate worker performance and establish wage incentives*

A final, but important, question to ask is, *Do work measurement programs pay for themselves?* Private industry has resisted the implementation of work measurement on DOD programs, in part, because they are afraid that the system will grow into a costly, burdensome reporting nightmare. The government takes a more positive view, estimating that the savings potential ranges from ten to twenty percent of direct labor cost, while the cost of work measurement programs is about one to four percent of direct labor. We are still gaining experience in this area, but industry surveys suggest savings to cost ratios of from 2:1 to 5:1. Only time will reveal whether industry fears of a costly and burdensome reporting system are well founded.

III. Transition from Development to Production:

Our final subject addresses an area that is highly likely to become *institutionalized* as a way of doing business by all three military services. In 1982, Mr. Will Willoughby was selected as chairman of a Defense Science Board task force on the subject of transition from development to production. We have the results of that study available to us in DOD manual 4245.70-OM, dated September 1985. Two things about the approach taken by the task force are particularly appealing: First, the results are practical. In the words of Mr. Willoughby, many acquisition studies have gone *cosmic*; that is, they have made suggestions that are beyond the ability of program managers, or even the DOD itself, to control. This study offers specific tools that managers can employ within the existing system. We don't have to rely on the unlikely possibility that someone else will change the system for us. Second, this approach integrates the entire acquisition process rather than sub-optimizing on only one aspect of it. The remainder of the article describes the problems that needed to be solved and the tools that the task force provided to do so.

An often discussed aspect of the acquisition process is the length of time it takes to develop and deploy weapon systems. Although there have been numerous attempts to shorten this cycle, if anything, it has only grown longer. The reasons for shortening the cycle are directed mainly toward cost, and to some extent -- though not enough -- toward readiness. Although the long acquisition cycle is certainly not desirable, it might be tolerable if the process yielded satisfactory results. But, many new weapon systems do not perform as *originally advertised* and, often require burdensome maintenance and logistics efforts.

Often, the first evidence of weapon system problems does not become apparent until the program attempts to transition from full scale development into production. Most acquisition managers seem to recognize that there is a risk associated with the transition but may not know the magnitude nor the origin. The task force felt that some of this uncertainty occurs because the transition is not a discrete event, but a process composed of three elements: design, test and production. Many programs simply cannot succeed in production, despite having passed the required milestone reviews. A poorly designed product cannot be efficiently tested, produced, or deployed. In the test program there will be far more failures than should be expected. Manufacturing problems will overwhelm production schedules and costs. The best evidence of this is the ***hidden factory syndrome***, with its needlessly high redesign and rework costs.

Corrective measures by DOD have focused on various management checkpoints and review activities. Gradually, numerous layers of management have been added that

have tended to compartmentalize and polarize the major areas of the acquisition process: design, test and production. The task force concluded that the causes of acquisition risk are more technical than managerial. The key to reducing risk is in *disciplined engineering* throughout these interrelated processes of design, test and production. Failure to do well in one area will result in failure to do well in the other areas.

The task force members, represented by DOD as well as private industry, drew upon their combined experience to generate a matrix of critical events in the design, test, and production processes. These events were then transformed into templates. A template describes three things for each event: (1) areas of risk, (2) an outline to reduce the risk, and (3) a timeline that shows when the activity should occur during the acquisition cycle. Risk is introduced to the program whenever a particular template activity begins late or does not finish on time. The major areas of funding, design, test, production, facilities, logistics, and management were chosen through analysis of recurring problems on a substantial number of programs. Funding was presented first because it influences every other template in the transition document.

There is a wealth of information and experience reflected in the templates. The manual that documents this information, DOD 4245-70-OM, should be a key reference available to all acquisition managers. Good luck in a very challenging career field. On a final note, in your endeavors to integrate knowledge of many diverse subjects, I urge you to take advantage of the expertise available through your co-located manufacturing representative.

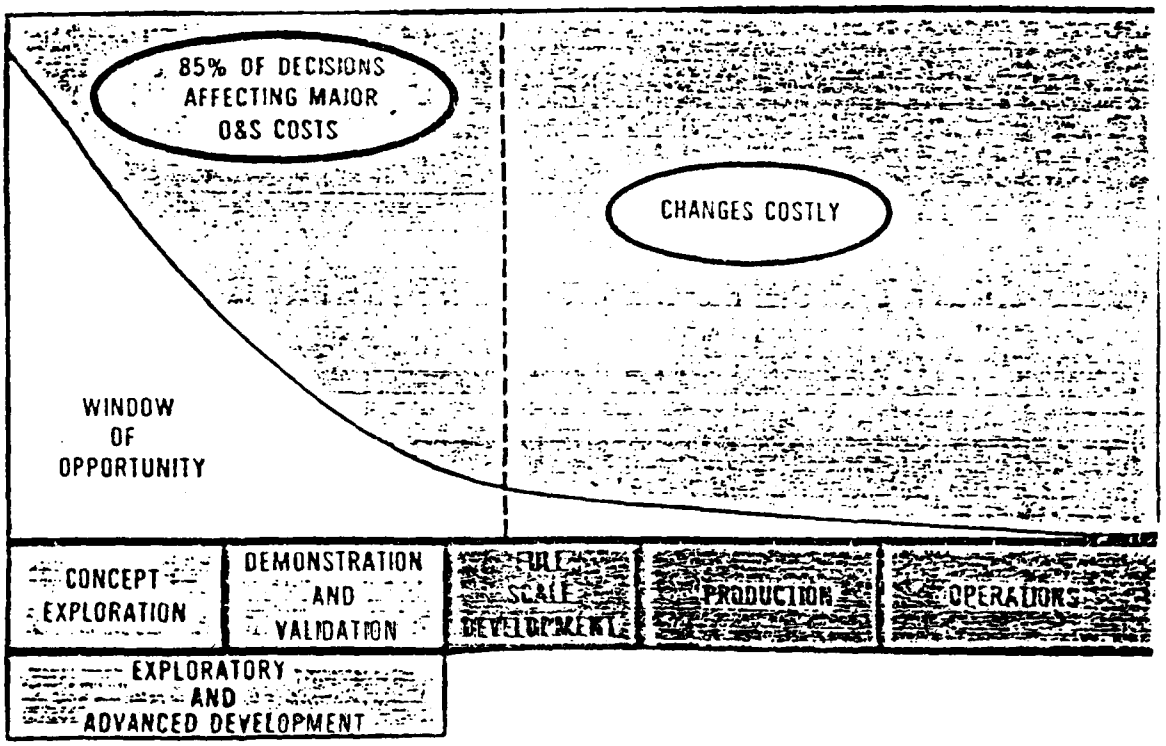
OVERVIEW

I. WHAT IS MANUFACTURING?

II. WHAT DOES MANUFACTURING DO AND WHEN?

III. INITIATIVES

COST REDUCTION OPPORTUNITY



CONCEPT EXPLORATION	DEMONSTRATION AND VALIDATION	FULL SCALE DEVELOPMENT	PRODUCTION
Evaluate Production Feasibility	Reassess Feasibility		
Assess Production Risk	Resolve Production Risk		
Manufacturing Strategy	Preliminary Manufacturing Plan	Final Manufacturing Plan Final Producibility	
	Preliminary Producibility	Production Readiness -- PRR -- LRIP	Execute Manufacturing Program Production Surveillance

FEASIBILITY ASSESSMENTS

PRODUCTION RISKS

PRODUCIBILITY ANALYSIS

PRRS

***

A SYSTEM DESIGN CONCEPT IMPLIES CERTAIN:

- RAW MATERIALS
- PRODUCT TECHNOLOGIES (*VHSIC*)
- MANUFACTURING TECHNOLOGIES (ELECTRON BEAM WELDING)

***

POTENTIAL TECHNOLOGIES

THERMOPLASTIC-MATRIX COMPOSITES/BISMALEMIDES	ALUMINUM METAL MATRIX COMPOSITES
COMPOSITES OUT OF AUTOCLAVE BONDING	LARGE PRECISION FORGINGS
ALUMINUM-LITHIUM ALLOYS	MOLDLINE FIDELITY TECHNOLOGY
VHSIC	CARBON-CARBON COMPOSITES
POWDER METALLURGY	NON-CONTACT LASER INSPECTION
GRAPHITE/EPOXY COMPOSITES	FUEL-TANK SEALING
ELECTRON-BEAM-WELDING OF TI	IMIP/TECH MOD PROJECTS
TITANIUM NEAR-NET SHAPE TECHNOLOGY	

***

MANAGING TECHNOLOGICAL RISK

MANTECH (MANUFACTURING TECHNOLOGY)

IMIP (INDUSTRIAL MODERNIZATION INCENTIVE PROGRAM)

FALL-BACK PLAN (ALTERNATIVE METHOD)

SYSTEM APPLICATION

MATERIAL	AIRCRAFT	MISSILES	SHIPS	VEHICLES	% IMPORTED	SUPPLIERS
COLUMBIAN	X	X	X		100	BRAZIL, THIALAND NIGERIA
MICA	X	X	X	X	100	INDIA, BRAZIL
COBALT	X	X	X	X	98	ZAIRE, OTHERS
TANTALIAM	X	X	X		95	THAILAND, CANADA
CHROMIUMS	X	X	X	X	91	S. AFRICA, USSR, TURKEY
ASBESTOS	X	X	X	X	86	CANADA, S. AFRICA
PLATINUM	X	X	X	X	80	S. AFRICA, U.K., USSR
TUNGSTEN	X	X	X		54	CANADA, BOLIVIA

MANAGEMENT OF CRITICAL ITEMS

MATERIAL MANAGEMENT PROGRAM

-- RECLAMATION/RECYCLE

-- SUBSTITUTION

MANTECH PROGRAMS

CONTRACTUAL INCENTIVES

ADVANCE PURCHASES

USE OF GOVERNMENT STOCKPILES

***

RISK CATEGORIES

1. STATE-OF-THE-PRACTICE
2. STATE-OF-THE-ART
3. EXPERIMENTAL

IMPLEMENTED IN CONTRACTS BY ORDERING MARKING OF DATA WITH DISTRIBUTION STATEMENTS WRITTEN ON ALL TECHNICAL DATA SUBMITTED

(BLOCKS 8 & 16, DD FORM 1423, CAN CITE OR REQUIRE DETERMINATION OF DISTRIBUTION STATEMENT)

Distribution Statement A:	Unlimited Distribution
Distribution Statement B:	U.S. Government Agencies Only
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Distribution Statement F:	Distribution as directed by DOD Controlling Office
Distribution Statement X:	U.S. Government Agencies and Private Individual Enterprises eligible to obtain export controlled technical data IAW 10 U.S.C 140c.

DATA MANAGER'S *TOOLS OF THE TRADE*

* AMSDL: Acquisition Management Systems and Data Requirements Control List (Now the DOD 5010.12-L) (formerly was the DOD 5000.19-L)

Listing of all approved Standard DIDs

* DID: Data Item Description (DD Form 1664)

Individual Description of One Collection of Recorded Information

Standard DID: Scientific/Technical (TYPE I)

or

Mgmt/Administrative (TYPE II)

Note: Office of Management & Budget (OMB) considers a DID a ***Rules Document*** which must have an OMB Control Number and Expiration Date Signifying if has been *Approved* by OMB per the Paperwork Reduction Act: PL 96-511

PRODUCIBILITY OBJECTIVES

MAXIMIZE:

- o SIMPLICITY OF DESIGN
- o USE OF ECONOMICAL MATERIALS
- o USE OF ECONOMICAL, PROVEN MANUFACTURING TECHNOLOGY
- o EARLY CONFIRMATION OF DESIGN ADEQUACY
- o PROCESS REPEATABILITY
- o PRODUCT INSPECTABILITY

MINIMIZE:

- o PROCUREMENT LEAD TIMES
- o GENERATION OF SCRAP AND WASTE
- o USE OF CRITICAL/STRATEGIC MATERIALS
- o DESIGN CHANGES DURING PRODUCTION
- o SPECIAL TOOLING AND TEST EQUIPMENT
- o UNIT/LIFE CYCLE COSTS
- o SKILL LEVELS OF PRODUCTION PERSONNEL

***

PRODUCIBILITY PRINCIPLES

COMBINE

ELIMINATE

STANDARDIZE

SIMPLIFY

FACILITATE

PRODUCTION READINESS REVIEW

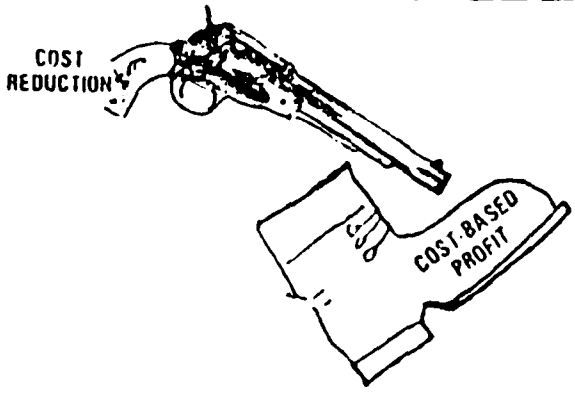
PART III OVERVIEW

INDUSTRIAL MODERNIZATION INCENTIVES PROGRAM

WORK MEASUREMENT

TRANSITION FROM DEVELOPMENT TO PRODUCTION

- REDUCED COST MEANS LOWER PROFITS



IMIP - DEFINITION

JOINT VENTURE

BUSINESS DEAL

-- SHARED RISK/FUNDING

-- SHARED BENEFIT

***

IMIP OBJECTIVES/BENEFITS

SHORT TERM:

INCREASED QUALITY (DO IT BETTER)

REDUCE LEADTIME (DO IT FASTER)

REDUCE COSTS (DO IT CHEAPER)

LONG TERM:

STRENGTHEN INDUSTRIAL BASE

PHASE I

TOP DOWN FACTORY ANALYSIS

DESIGN/PLAN

COST AND TECHNICAL PROPOSAL - PHASE II

NEGOTIATE BUSINESS DEAL

* * *

PHASE II

DEVELOP TECHNOLOGIES/WORK CENTERS

BUILD/DEMONSTRATE PROTOTYPES

PLAN FOR IMPLEMENTATION

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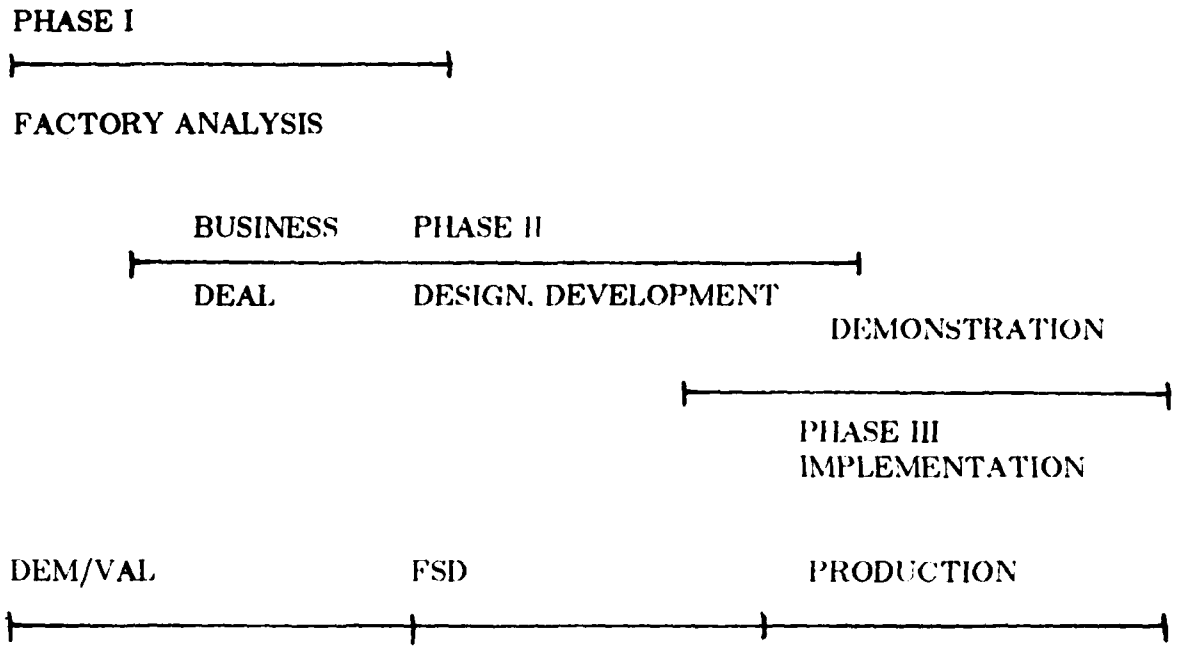
PHASE III

IMPLEMENTATION

ASSESSMENT/DISTRIBUTION OF BENEFITS

TECHNOLOGY TRANSFER

APPROXIMATE IMIP TIMING

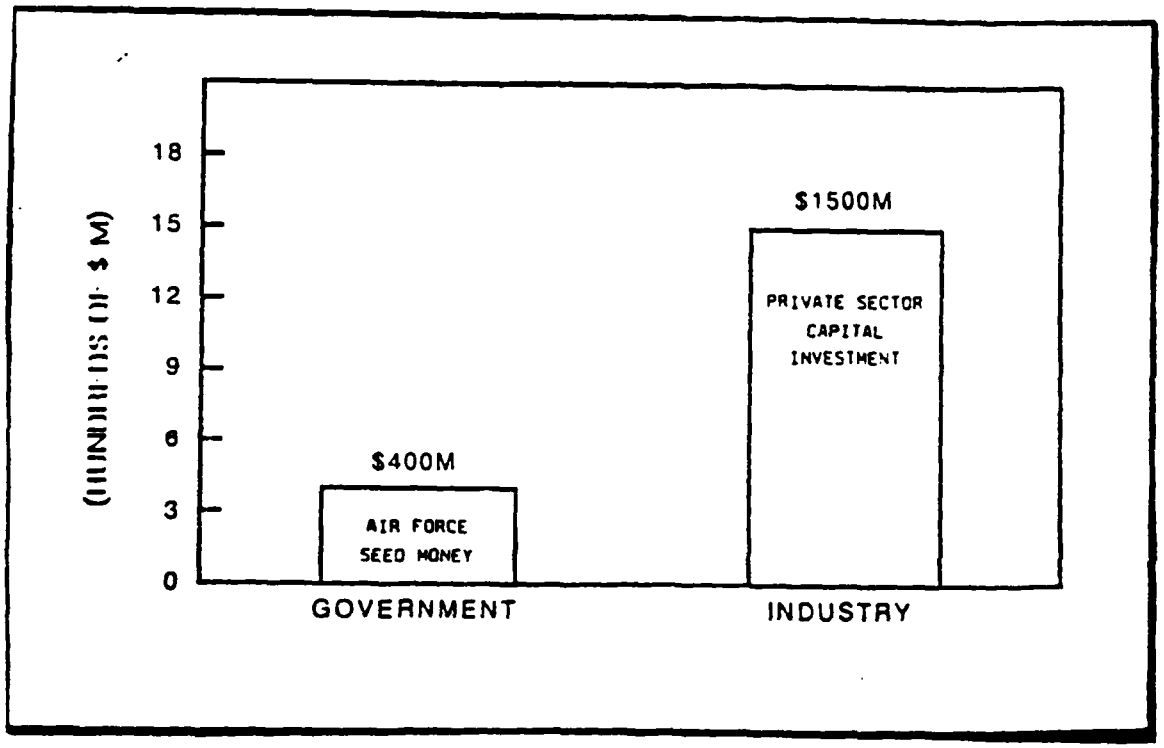


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BUSINESS DEAL

* FUNDING
* SAVINGS
* VALIDATION OF SAVINGS
* INDEMNIFICATION

IMIP FUNDING LEVERAGE



WHAT IS WORK MEASUREMENT?

METHOD FOR EVALUATING EFFICIENCY

* DEFINES HOURS FOR A JOB* (STANDARD)

* MEASURES ACTUAL HOURS USED

* COMPARES:

EFFICIENCY = STANDARD HOURS/ACTUAL HOURS

VS.

PERFORMANCE = ACTUAL HOURS/STANDARD HOURS

* ANALYZE PERFORMANCE, ADDRESS PROBLEM AREA

**TRAINING

**METHOD

**LAYOUT

**MANAGEMENT PROCEDURES

EXAMPLE

STANDARD HOURS = 20 MINUTES

ACTUAL TIME = 30 MINUTES

EFFICIENCY = 20/30 = 67%

PERFORMANCE = 30/20 = 1.5

LABOR TIME STANDARD

THE TIME IT *SHOULD TAKE* A *NORMALLY SKILLED* OPERATOR FOLLOWING A *PRESCRIBED METHOD*, WORKING AT A NORMAL *ALL-DAY LEVEL OF EFFORT*, TO COMPLETE A *DEFINED TASK* WITH *ACCEPTABLE QUALITY*.

***

DOD RECOGNIZES TWO CATEGORIES OF TIME STANDARDS

- TYPE I, ENGINEERED STANDARDS

  TIME STUDY

  PREDETERMINED DATA
  -- METHODS TIME MEASUREMENT (*MTM*)
  -- BASIC MOTION TIME STUDY (*BMT*)

  STANDARD DATA

  WORK SAMPLING

- TYPE II, ESTIMATED STANDARDS

  BASED ON EXPERIENCES/HISTORICAL PROJECTION

  LESS RELIABLE - SOMETIMES MORE COST EFFECTIVE

APPLICABILITY

- o FSD PROGRAMS EXCEEDING $100M
- o PRODUCTION PROGRAMS EXCEEDING $20M ANNUALLY OR $100M CUM
- o SUBCONTRACTS EXCEEDING $5 MILLION ANNUALLY OR $25 CUM
- o EXCLUSIONS

  -- CONSTRUCTION
  -- FACILITIES
  -- OFF-THE-SHELF COMMODITIES
  -- TIME AND MATERIALS
  -- RESEARCH
  -- STUDY
  -- NON-ACQUISITION CONNECTED DEVELOPMENT
  -- SHIP CONSTRUCTION
  -- SHIP SYSTEM CONTRACTS
  -- SERVICE TYPE CONTRACTS

BENEFITS

ACCURATE TIME STANDARDS

IMPROVE COST ESTIMATES

IMPROVE BUDGET ESTIMATES

IMPROVE SCHEDULING

IMPROVE LAYOUT/MATERIALS HANDLING

PERFORMANCE ANALYSIS:

REDUCE COSTS

IMPROVES METHODS/PROCESSES

REDUCES SCRAP/WASTE

EVALUATES WORK FORCE

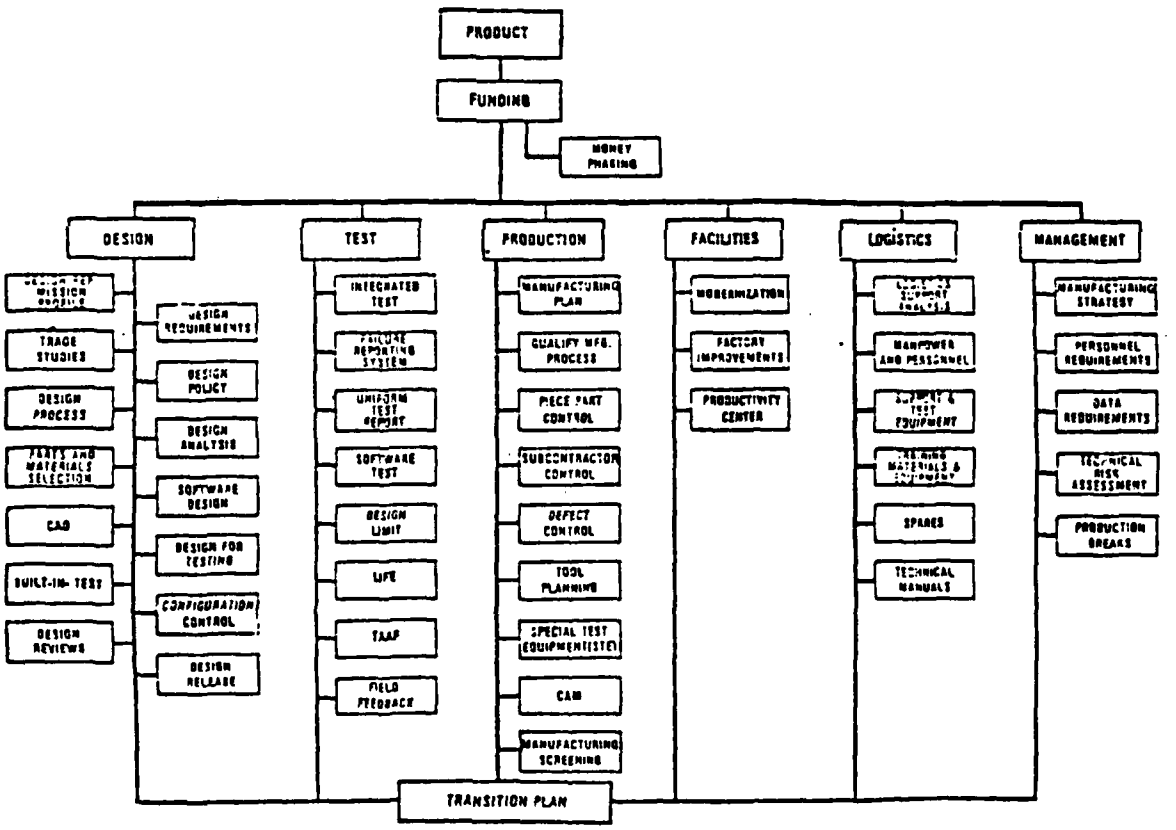
BENEFITS VERSUS COST

o APPLICATION OF MIL-STD 1567A OFFERS SAVINGS POTENTIAL OF FROM 10-20% OF DIRECT LABOR COST

o WORK MEASUREMENT PROGRAMS COST MONEY - A RANGE OF FROM 1- 4% OF DIRECT LABOR HOURS

o RATIO OF SAVINGS TO COST VARY FROM 2:1 TO 5:1

TEMPLATES - ORGANIZATION



FUNDING - AREA OF RISK

TWO RISK AREAS:

1. Inadequate early RDT&E funds
2. Inadequate early production funds

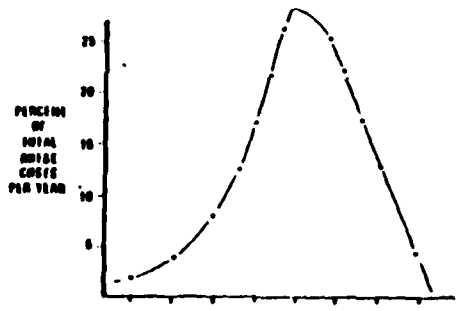


Figure 2-2. What We Do (RDT&E Funding Profile)

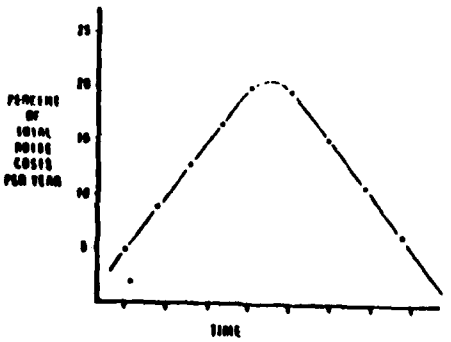


Figure 2-1. What We Should Do (RDT&E Funding Profile)

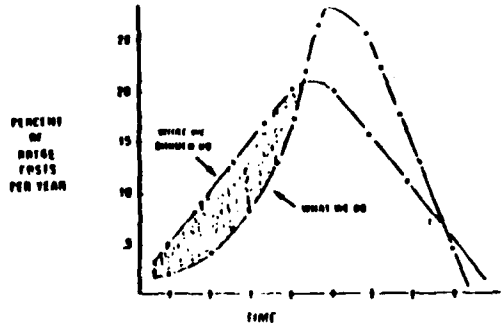


Figure 2.3 The "Design and Engineering" Gap

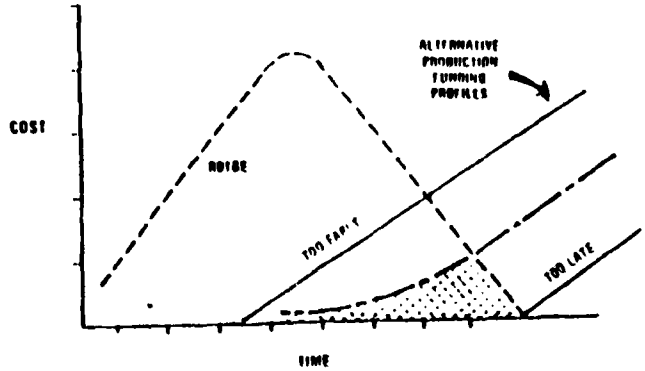


Figure 2-4. Funding Profiles (RDT&E and Production)

LESSON 14

LESSON TITLE: **Test and Evaluation**

TIME: 2 hrs

LESSON OBJECTIVE: The objective of this lesson is for each student to know the purpose of test and evaluation and the organizations involved in test and evaluation.

SAMPLES OF BEHAVIOR:

a. State the purpose of Development T&E (*DT&E*).

b. State the purpose of Operational T&E (*OT&E*).

c. State the primary role of AFOTEC.

d. Describe how the test effort is integrated into the acquisition program.

e. List the documentation associated with testing.

f. Identify the AFSC test organizations that can act as an RTO or PTO and understand their role in the DT&E process.

TOPIC INTRODUCTION:

Test and Evaluation is one of the most costly important areas in the acquisition arena. After all, in order for us to get information to do analyses, comparisons, and evaluations, we need information, which can be very expensive to acquire. Test and Evaluation gives you that information. Recent acquisition reform legislation, like the *Packard Commission Report*, emphasized the importance of testing the system as early as possible before locking into concrete decisions. Lesson 14 addresses the concept of testing in the acquisition environment. The purpose of Development and Operational Test and Evaluation is introduced, as well as how these activities fit into the acquisition life cycle. Next, the role of one of the operational implementers of test policy, the Air Force Operational Test and Evaluation Center (*AFOTEC*), and the documentation that is important in providing test plans and results, are addressed. As program manager, you should be concerned about the test requirements for your program. Operational tests can be very complicated, time consuming, and expensive. Numerous subjective judgements go into validating whether or not the threat simulators and targets really simulate hostile forces, and whether the tests are realistic enough, despite the artificiality of the test rules of engagement.

METHOD OF INSTRUCTION: Lecture/Discussion

INSTRUCTIONAL MATERIALS:

a. Article: *Test and Evaluation*, by Major's Huffman, Lozito, and Snyder, May 1981, ACSC, AU, AFIT/LSY

b. Article: *RTO/PTO Organizations*, by Capt Adler, AFIT/LSY

c. *Test and Evaluation* videotape

d. Lesson viewgraphs

AUDIO-VISUAL AIDS: Chalkboard

INSTRUCTIONAL EQUIPMENT: Video monitor and 3/4" tape player

REFERENCES:

a. DODD 5000.3, 12 Mar 86, *Test and Evaluation*

b. AFR 80-14, (3 Nov 86), *Test and Evaluation*

c. AFP 55-43, (28 Jun 85), *Management of Operational Test and Evaluation*

d. AFSCP 80-27 (26 Jan 81), *Summary of AFSC Major Ranges and Test Facilities*

REQUIRED STUDENT PREPARATION:

a. Read article: *RTO/PTO Organizations*

b. Read article: *Test and Evaluation*

c. Scan lesson viewgraphs

DISCUSSION QUESTIONS:

1. The Department of Defense, as well as industry, spends billions of dollars on research and development. There is a steady stream of requests for more programs to be funded for R&D and decision makers must choose which programs to fund and which ones to drop.

a. What criteria would you use, if you were one of these decision makers, to choose from among the programs?

b. What types(s) of information would you need, and how would you get this information?

2. There are two types of test and evaluation associated with the acquisition process: Development Test and Evaluation (*DT&E*) and Operational Test and Evaluation (*OT&E*). What in your opinion, is the purpose of DT&E? Can you provide examples of OT&E?

3. If we find, through DT&E, that a system or subsystem fails to meet a specification, should we waive the specification or enforce the contract?

a. What do we mean when we say a system has been over specified? How do we know? What should we do about it?

b. What do we mean when we say a system has been under specified? How do we know? What should we do about it?

[Acronyms introduced in this lesson, and their description]

Chapter 14

ADTC	Armament Development Test Center
AEDC	Arnold Engineering & Development Center
AFFTC	Air Force Flight Test Center
AFOTEC	Air Force Operational Test and Evaluation Center
JCS	Joint Chiefs of Staff
JT&E	Joint Test and Evaluation
JTD	Joint Test Director
JTF	Joint Task Force
MST&E	Multi-Service Test and Evaluation
PTO	Participating Test Organization
QOT&E	Qualifying Operational Test & Evaluation
QT&E	Qualification Test and Evaluation
RTO	Responsible Test Organization
SAF	Secretary of the Air Force
TEMP	Test and Evaluation Master Plan
TPWG	Test Plan Working Group

TEST AND EVALUATION

Thus far you have "survived" the introduction to the kingdom of acquisition. Now it is really time to put your interest to test. Test and Evaluation commences as early as possible in the acquisition process and continues throughout the entire system life cycle. Moreover, sufficient T&E must be accomplished successfully before decisions will be made to commit significant additional resources to a program or to advance it from one acquisition phase to another. While conducting T&E, quantitative data must be used to the maximum extent possible, thereby minimizing subjective judgments. Well, what are the main purposes of T&E? Essentially, they encompass (1) the assessment and reduction of risks; (2) the evaluation of the system's operational effectiveness and suitability; and (3) the identification of system deficiencies. As you can see, that is not only a mouthful to say, but also a Goliath to conquer. Nonetheless, the difficulty of the task is probably equal to its importance to the program, for it

- Allows early evaluation of program's technical and operational feasibility.
- Facilitates earlier, less costly correction of system deficiencies and shorter schedules.

Additionally, at the DAB/AFSARC reviews, much of the information used to assess program progress is derived directly from T&E results. The bottom line then is that the results from T&E significantly affect the future of the program -- whether it advances, changes, or dies.

TEST AND EVALUATION DIRECTORATE ORGANIZATION

Within a Program Office (*PO*), a typical T&E directorate is not a simple thing to define. Depending on the number of programs involved, and their size and complexity, the organization can vary from a deputy director for large programs, chief of a division for other small programs, to possibly only one or two individuals for small or one-of-a-kind programs. In any case, while the complexity, schedules, and resource planning may change, the mission of the organization does not. Regardless of type organization, the "testers" must plan, coordinate, and manage the program test activities within policies set by the Program Manager. The larger programs usually require more schedule and test disciplines due to more test articles and, possibly, more complex operations. However, testing smaller programs should receive the same emphasis within the PO as the large programs.

TEST AND EVALUATION CATEGORIES

Looking at the kinds of T&E, there are essentially two: Development Test and Evaluation (*DT&E*) and Operational Test and Evaluation (*OT&E*). OT&E, associated with an R & D program, is further sub-divided into two phases: Initial Operational Test and Evaluation (*IOT&E*) and Follow-on Operational Test and Evaluation (*FOT&E*). The transition point for these two phases is Milestone III (Production decision). Finally, for certain programs/subsystems such as non-research and development funded programs, joint programs, and computer software subsystems, modified or specialized testing requirements apply. Let's now look at each of these T&E categories.

DEVELOPMENT TEST AND EVALUATION (*DT&E*)

Through DT&E, the Air Force demonstrates that the system engineering design and development is complete, design risks have been minimized, and the system will perform as required and specified. DT&E includes the test and evaluation of components, subsystems, hardware/software integration, associated software, and pre-production models of the systems. It involves an engineering analysis of the systems performance, including its limitations and safe operating parameters. Furthermore, the system is evaluated against engineering and performance criteria specified by the implementing command. Also addressed are the logistics engineering aspects (supportability, maintainability, reliability, etc.) as well as compatibility and interoperability with existing or planned systems. DT&E usually commences in the Concept Exploration/Definition phase and continues through the Full-Scale Development phase. Furthermore, it may embrace testing of system improvements or modifications designed to correct deficiencies or to reduce life cycle costs. In summary then, overall DT&E objectives encompass the following:

- 0 Assess system specification compliance, deficiencies, compatibility, OT&E readiness, configuration changes
- 0 Assess program risks/tradeoffs
- 0 Assess logistics supportability/survivability
- 0 Verify technical order completeness
- 0 Gather training program and environmental impact data
- 0 Determine system performance limitations

The implementing command, normally AFSC, manages DT&E. AFSC assigns this responsibility to the Program Manager (*PM*). The PM then designates a DT&E test director (sometimes himself) to exercise control over the DT&E test team and associated resources. Besides the Program Office (*PO*), the OT&E, operating, and supporting commands participate in the DT&E effort as directed by program directives and coordinated planning documents. (Note: The OT&E command normally, for major and HQ USAF designated non-major programs, is the Air Force Operational Test and Evaluation Center (*AFOTEC*) *while a Major Command (MAJCOM)* is normally assigned as the OT&E command for other non-major system programs.) In addition to the governmental agencies, the contractor plays a key role in the DT&E, especially in the early part of the test program. A contractual system test plan is developed jointly by the PO and the contractor. It identifies the roles of each participant. Finally, the specifics on DT&E management are documented in each program's Test and Evaluation Master Plan (*TEMP* – see discussion later in chapter).

QUALIFICATION TEST AND EVALUATION (*QT&E*)

QT&E is the testing performed, in lieu of DT&E, on programs where there is no research, development, test and evaluation (*RDT&E*) funding. These programs might include Class IV/V modifications, simulators, software programs, and off-the-shelf equipment. QT&E is usually performed by the implementing command. Essentially, the same test policies for DT&E apply to QT&E.

OPERATIONAL TEST AND EVALUATION (*OT&E*)

OT&E is the T&E conducted to (1) estimate a system's operational effectiveness/suitability, (2) identify needed modifications, and (3) provide information for tactics, doctrine, computer documentation, technical data, training, programming, organization, and personnel requirements. It is conducted throughout the system life cycle in as realistic conditions as possible. OT&E uses personnel with the same type of skills and qualifications as those who will operate, maintain, and support the deployed system. As previously mentioned, OT&E includes two sub-phases: IOT&E and FOT&E. IOT&E is conducted to provide a valid estimate of a system's operational effectiveness/suitability and is normally completed prior to the first major production decision. Typically, the OT&E command accomplishes this testing on pre-production, prototype or pilot production items. FOT&E is usually conducted after the first major production decision or after the first production article has been accepted. It may continue throughout the weapons systems' life cycle. FOT&E may be divided into two phases, cleverly designated FOT&E (I) and (II). FOT&E (I) is conducted after IOT&E and is used to refine operational suitability/effectiveness estimates and to evaluate corrective changes made during IOT&E. The OT&E command determines the transition to the second phase (FOT&E *(II)*) and this transition varies on a program-by-program basis. FOT&E (II) measures the system's ability to meet changing operational requirements, refines operational tactics and programs, and identifies and confirms correction of system deficiencies. In summary, then, as the Air Force conducts OT&E, its overall objectives include

- 0 Estimate operational effectiveness/suitability
- 0 Identify operational deficiencies
- 0 Recommend/evaluate configuration changes
- 0 Provide logistics support, training, tactics, operation and support cost data
- 0 Determine tech data/support equipment adequacy
- 0 Estimate system survivability

As discussed under DT&E, the management of OT&E rests with either AFOTEC or MAJCOMS depending upon the program designation. (Note: AFOTEC is the assigned focal point for all AF OT&E, responsible for providing OT&E information to HQ USAF and the Secretary of Air Force (*SAF*) for support of program reviews. As a result, for

MAJCOM-managed OT&E, AFOTEC monitors the program and approves all test plans.) The OT&E Command (AFOTEC or MAJCOM) designates and provides the OT&E test director, who exercises control over the OT&E test team and resources. The OT&E test director works closely with the Program Manager (*PM*) and informs him immediately of any identified system deficiencies. While the OT&E test agency is responsible for OT&E management, the PM remains responsible for the rest of the program. Before continuing, let's look briefly at the concept of combined testing. During the early test planning stages, one of the considerations is to establish a test program which uses resources in the most cost effective manner. If separate testing (separate DT&E and OT&E testing) would cause either a significant program delay or a significant increase in cost/resources, development and operational testing are combined, where possible. This combined testing will include both combined and separate DT&E and OT&E test events to satisfy all of the test objectives. Moreover, the development and operational evaluations are performed independently. Test management responsibilities are similar to those previously discussed: the implementing command manages the DT&E while the OT&E command manages the OT&E. The implementing command is responsible for integrating the two test plans together. In accordance with the combined test plan, directors will, during the testing efforts, share resources and provide support to each other.

QUALIFICATION OPERATIONAL TEST AND EVALUATION (*QOT&E*)

Like QT&E, QOT&E is performed, in lieu of IOT&E, on programs where there is no RDT&E funding. Either AFOTEC or the designated MAJCOM conducts the QOT&E. Essentially, the same test policies for IOT&E apply to QOT&E. QOT&E is usually done before the first production article is accepted. However, HQ USAF may direct that it be done before the initial production decision. For one-of-a-kind production systems, Air Force acceptance may come before QT&E and QOT&E. Following QOT&E, FOT&E is conducted, as appropriate.

JOINT PROGRAM TEST AND EVALUATION

A joint program T&E exists when two or more services or Department of Defense (*DOD*) agencies participate in the testing effort. There are two kinds of joint program T&E: multi-service T&E (*MST&E*) and joint T&E (*JT&E*). MST&E involves acquisition program testing, while JT&E involves non-acquisition testing.

MULTI-SERVICE TEST AND EVALUATION -- MST&E involves T&E conducted by two or more services (or DOD agencies) for systems to be acquired by more than one service. Additionally, MST&E is performed when one service's system interfaces with equipment of another service. This testing may include either DT&E, or OT&E, or both. The lead service, as directed by OSD, manages the MST&E effort in accordance with its service regulations (for example, if the Air Force was the lead service, AFR 80-14 procedures would be used). If another service has certain unique T&E requirements, deviations may be accommodated by mutual agreement.

JOINT TEST AND EVALUATION - JT&E will be conducted when OSD (specifically the Office of the Under Secretary of Defense) decides it necessary to

- 0 Examine the capability of developmental/deployed systems to perform their intended mission.
- 0 Evaluate technical concepts, system requirements, improvements or interoperability.
- 0 Provide information for force structure planning.
- 0 Gather data on joint doctrine, tactics, or procedures.

Testing will be accomplished in the most realistic operational environment feasible. OSD delegates test management responsibilities to one of the services. The selected service nominates a Joint Test Director (*JTD*) for OSD approval. The JTD, once confirmed, is responsible for developing test plans, establishing the Joint Task Force (*JTF*), achieving the test objectives, and preparing the required reports. He is assisted by the JTF, which consists of AFOTEC, MAJCOM, and other participating agencies' personnel. The JT&E final report is approved by OSD and distributed to all the services and, the Joint Chiefs of Staff (*JCS*).

COMPUTER SOFTWARE TEST AND EVALUATION

Not a soft area by any stretch of the imagination. During the acquisition process, quantitative and demonstrable performance objectives must be set for computer software, and the testing must be structured to demonstrate that software has reached a level of maturity proper to each phase. For embedded software, performance objectives must be included as a subset of the overall system. The T&E master plan (*TEMP* -- see later discussion) enumerates the software test objectives and test management responsibilities. Before software is released for operational use, it must undergo sufficient operational testing to adequately estimate the system's operational effectiveness/suitability. Such testing should encompass combined hardware/software interface and maintainability testing, using typical operator personnel. Software objectives will be included as a part of the DT&E/OT&E test objectives. The importance of comprehensive software testing cannot be overemphasized.

MAJOR TEST DOCUMENTATION

The following list is by no means exhaustive; however, it briefly describes the key documents involved in T&E management. Not listed are the Decision Coordinating Paper (*DCP*) and Program Management Directive (*PMD*). As you may recall, the DCP was the principal document used to record essential program information for use in the SECDEF decision-making process. In the T&E context, this document records critical issues/areas of risk, accomplished T&E results, etc., for support of the program milestone decisions. Successful T&E progress is necessary before the system can move into the next acquisition phase. The PMD is the HQ USAF management directive providing direction

and tasking to the implementing and participating commands. Within this document, the responsibilities for test management and support are assigned. Now that you recall these documents, let us look at the documents more intrinsic to the T&E business:

0 PROGRAM MANAGEMENT PLAN (*PMP*), TEST SECTION -- In general, the PMP is developed by the PM and shows the integrated time-phased tasks/resources required for the program. The test section contains overall test objectives, test management concept/responsibilities, necessary test resources, and critical issues and areas of risks. Because of overlapping information, this section often references the TEMP rather than repeat TEMP material.

0 TEST AND EVALUATION MASTER PLAN (*TEMP*) -- Primary document used to assess adequacy of planned T&E. It contains

-- Mission/system description
-- Required operational/technical characteristics
-- Critical technical/operational issues
-- Test management responsibilities
-- DT&E and OT&E outlines, to include objectives
-- Test resource summary

The PM prepares the TEMP with assistance from the Test Planning Working Group (*TPWG*). This group consists of personnel from the PO, test agencies, AFOTEC, operating and supporting MAJCOMS, contractor (when appropriate), and other involved test agencies. Besides providing assistance in the initial TEMP preparation, the TPWG meets periodically to update test plans and monitor test progress. The TEMP is coordinated with all affected agencies. For major systems the TEMP is approved at the Under Secretary of Defense level.

RTO/PTO Organizations

As was mentioned in the "Test and Evaluation" article, the implementing command, normally AFSC, manages DT&E. This responsibility, then, for management of DT&E rests with the program manager. The program manager is normally assisted by a responsible test organization (*RTO*) appointed by HQ AFSC. The RTO is normally delineated in the PMD. The program manager or RTO may also receive assistance from a participating test organization (*PTO*). The RTO and PTO are normally chosen from AFSC test resources, such as the Air Force Flight Test Center (AFFTC), Arnold Engineering and Development Center (AEDC), Armament Development Test Center (ADTC), 4950th Test Wing, and other laboratories and centers.

The RTO normally appoints a test manager and prepares a test plan. There may be a feeling, at times, that the RTO has usurped the power of the program manager in its actions. The truth is that the RTOs function is to test and maintain a capability in test management and test facilities. The RTO test plan is submitted to the program manager for approval and then to AFOTEC for review and comment. The RTO then conducts the test with participation by AFOTEC and the user/support commands as required. The report is normally prepared by the RTO and may be approved for publication by the RTO or the program manager. Normal coordination procedures would seem to dictate that the program manager would have control over these reports. However, the centers are justly proud of their objective test capability and ability to publish their findings with integrity. It is up to the program manager to resolve any problems that impact upon his program as a result of the RTO's rigorous tests.

TEST and EVALUATION

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TEST AND EVALUATION

The primary purpose of all T&E is to make a direct contribution to the timely development, production, and fielding of systems that meet the user's requirements and are operationally effective and suitable.

BACKGROUND

LATE 1960's — EARLY 1970's

STUDIES

- BLUE RIBBON DEFENSE PANEL
- COMMISSION ON GOVERNMENT PROCUREMENT
- GAO
- CONGRESS
- HQ USAF TEST CONCEPT REVIEW BOARD

MAJOR T & E FINDINGS

- CONCURRENCY
- OVER DEPENDENCY ON CONTRACTORS
- EARLIER OPERATOR FEEDBACK
- MORE TIMELY TEST RESULT REPORTING
- IMPROVED OBJECTIVITY

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CURRENT POLICY

(DOD DIRECTIVE 5000.3)

- EARLY IDENTIFICATION OF TEST OBJECTIVES
- CONTINUOUS TESTING THROUGHOUT ACQUISITION PROCESS
- TEST & EVALUATION MILESTONES MET PRIOR TO KEY DECISIONS
- INDEPENDENT AGENCY RESPONSIBLE FOR OPERATIONAL TESTING
  - SEPARATE FROM DEVELOPER AND USER
  - REPORTS DIRECTLY TO SERVICE CHIEF

TEST AND EVALUATION

...conduct of appropriate T&E will be a key requirement for decisions to commit significant additional resources to a program, to advance it from one acquisition phase to another, and to field a system.

DODD 5000.3

AIR FORCE INSTITUTE OF TECHNOLOGY

AIR FORCE OPERATIONAL TEST & EVALUATION CENTER

- SEPARATE OPERATING AGENCY
- INDEPENDENT FROM DEVELOPING AND USING COMMANDS
- REPORTS TO AIR FORCE CHIEF OF STAFF
- PRINCIPLE ELEMENTS:
  - HEADQUARTERS
  - FIELD TEST TEAMS

MANAGEMENT OF DT&E

To demonstrate that

- Engineering is reasonably complete
- All significant design problems are identified
- Solutions to these problems have been developed

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DT&E OBJECTIVES

- Assess the critical issues
- Determine how well specifications have been met

CRITICAL ISSUES

Those aspects of a system's capability, either operational, technical or other that must be answered before a system's overall worth can be estimated, and that are of primary importance to the decision authority in deciding to allow the system to advance into the next acquisition phase.

DODD 5000.3-M-1

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OT&E MANAGEMENT

The primary purpose of OT&E is to ensure that only operationally effective and suitable systems are delivered to the operating forces.

OT&E MANAGEMENT

OT&E is the field test, under realistic conditions, of any item of weapons, equipment, or munitions for the purpose of determining the effectiveness and suitability of the weapons, equipment, or munitions for use in combat by typical military users;

and the evaluation of the results of such tests.

DODD 5000.3

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OT&E OBJECTIVES

- Evaluate operational effectiveness
- Evaluate operational suitability
- Answer unresolved critical operational issues

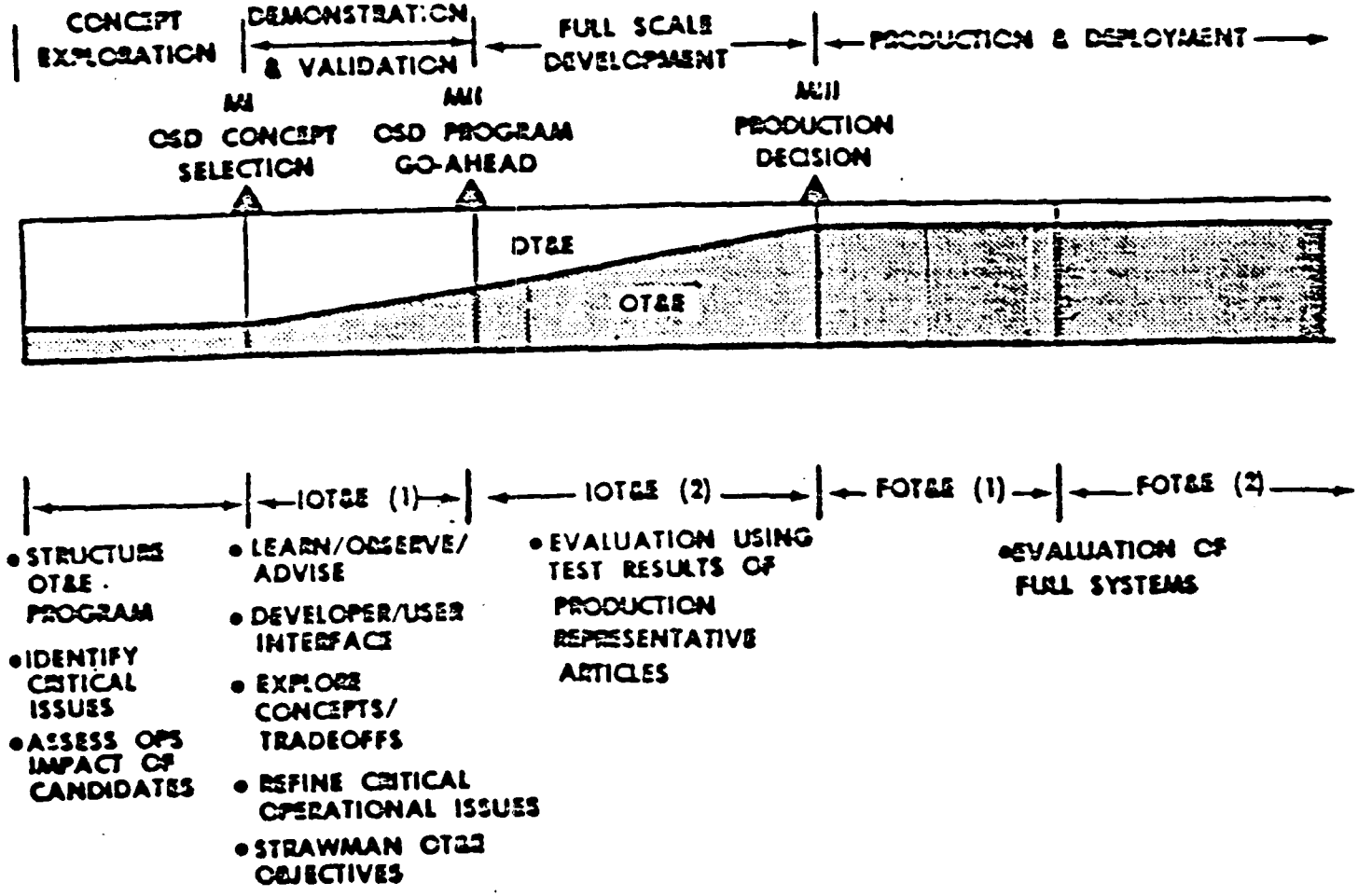


FIGURE 1-1. THE ACQUISITION PROCESS

LESSON 15

LESSON TITLE: **Program Control/Cost Estimating**

TIME: 1.5 hrs

LESSON OBJECTIVE: The objective of this lesson is for each student to know the role of program control and cost estimating in the management of an acquisition program and how the WBS facilitates this role.

SAMPLES OF BEHAVIOR: The student should:

a. List the three divisions of program control.

b. Describe how the WBS supports the program control and cost estimating function.

c. List four areas of the budget process.

d. Describe the characteristics of an acceptable cost estimate.

e. List the various categories and requirements of cost estimates.

f. Outline some of the major reasons of weapon system cost growth.

TOPIC INTRODUCTION:

Congratulations, you have made it to the final lesson in SYS 100. Program Control/Cost Estimating, though the last block, does not imply that it is the least important. Rather, this block tends to focus all the functional areas in one important area -- financial management. After all, if you did not have the funds to complete a project, you would have to address other ways to still meet program direction or reducing the scope of the program. Program Control can help you in this process, by providing the necessary information on which to make important program decisions. Program Control can assist all the functional divisions, found in a typical System Program Office, by being the cost and schedule experts. This lesson introduces you to the common types of work found in Program Control, some of the tools used to track costs and schedule, the characteristics of cost estimating, and some of the reasons for weapon system cost growth.

You will probably agree that this is a lot of information for an introductory course. Unfortunately, there is no way of teaching just one lesson of this material without an appreciation of the other processes, regulations, and disciplines involved. Fortunately, you have this workbook to which you can always refer in the future and build upon your acquisition experiences.

Good Luck!!!

METHOD OF INSTRUCTION: Lecture/Discussion

INSTRUCTIONAL MATERIALS:

a. Article: *Program Control and Cost Estimating*, by Capt Adler, AFIT/LSY

b. *Program Control/Cost Estimating* videotape

c. Lesson viewgraphs

AUDIO-VISUAL AIDS: Chalkboard

INSTRUCTIONAL EQUIPMENT: Video monitor and 3/4" tape player

REFERENCES:

a. AFSCP 800-3, *A Guide for Program Management*

b. AFR 800-25, *Acquisition Program Baselining*

c. MIL-STD-881A, *Work Breakdown Structure for Defense Material Items*

d. AFR 800-17, *Work Breakdown Structure (WBS) for Defense Material Items*

e. AFR 173-1, *The Air Force Cost Analysis Program*

REQUIRED STUDENT PREPARATION:

a. Read article: *Program Control and Cost Estimating*

b. Scan lesson viewgraphs

DISCUSSION QUESTIONS:

As program manager, you have been tasked to provide and present a cost estimate on your program for AFSARC review. Your program is a Non-Major program in Full-Scale Development and has a one-year old cost estimate. You want to update your cost estimate, because of all the changes that have impacted your program, and you want to see what impact these have on the cost of the program. To assist you, the Comptroller has provided a new cost analyst to your program office.

1. What factors do you consider most important in bringing the cost analyst onto *your* acquisition team?

2. What factors do you think might be encountered in developing and presenting a cost estimate, with regard to weapon system cost growth?

3. What information will the cost analyst need to complete the estimate, and why is it important? Is it always possible to get the information you need? What might constrain the information gathering process?

4. Your new Program Control Chief is considering ways to improve the program evaluation process within your program office. In order to do this, you need a complete analysis of what program control's responsibilities include. What is the primary role of program control, and what issues and items should you address first with the new Program Control Chief?

[Acronyms introduced in this lesson, and their description]

Chapter 15

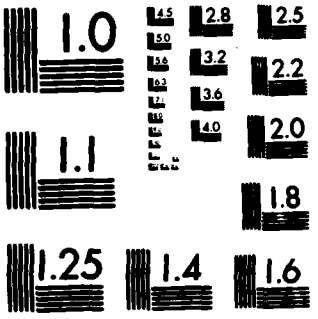
BES	Budget Estimate Submission
C/SCSC	Cost/Schedule Control Systems Criteria
C/SSR	Cost/Schedule Status Reviews
CFSR	Contract Funds Status Reports
CPR	Cost Performance Reports
EAC	Estimate at Completion
ICA	Independent Cost Analysis
ICS	Independent Cost Study
ISA	Independent Schedule Assessment
ISR	Independent Sufficiency Review

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PROGRAM CONTROL

AND

COST ESTIMATING

The Air Force program manager is the single point of responsibility in acquiring and deploying weapon systems to satisfy operational needs. The program control directorate, which serves the program manager, attempts to facilitate the goal of producing systems within schedule and acceptable cost constraints while meeting performance and logistic supportability requirements. Program control personnel frequently develop key contacts in and out of the government to carry out their responsibilities. They essentially become filter devices of information to the program manager so that issues and challenges are elevated and answered quickly and thoroughly. Sometimes informal contacts may be the best avenues for controlling costs, schedule, performance, or supportability.

Functionally, program control is typically divided into three unique divisions depending on the type of work involved. The program evaluation division deals with the contractor while monitoring the costs of the program; the financial management division focuses on identifying and monitoring funds to keep the program moving; and the plans and integration division deals with non-financial aspects of the System Program Office (*SPO*) like planning, scheduling, and forecasting. Some program offices may not be organized this way, but the type of work done in each division is typical of what goes on in any program control directorate. The following is a summary analysis of the special considerations of each program control division.

Program evaluation is really program analysis of costs in support of the financial manager. By interfacing with the financial managers, program evaluation identifies the cost requirements and the cost performance of the contractor. Some activities one normally finds in program evaluation are Cost/ Schedule Control Systems Criteria (*C/SCSC*) and Cost Analysis. C/SCSC deals with performance measurement using Cost Performance Reports (*CPR*), Contract Funds Status Reports (*CFSR*), and Cost/Schedule Status Reviews (*C/SSR*) all used to track and analyze the contractor's performance. The emphasis in cost analysis, from a program control perspective, is in tying the contractor's Estimate At Completion (*EAC*) to your SPO budget.

Some of the end products of program evaluation are selection of the best contractor in source selections, periodic review of the SPO estimate for sufficiency, Program Objective Memorandum (*POM*) or Budget Estimate Submission (*BES*) budget support with financial managers, future billings and budget forecasts, and support for impact statements and *what-if* exercises in budget and briefing cycles.

Financial management, on the other hand, deals with the management of program funds and the process of budget requests. Some feel this is the heart of any program since if you did not have funds to run your program, you would not have a program. Typical financial management functions are budgeting, financial analysis, fund administration, fiscal integrity and accountability, appropriation integrity, and support of the program manager. Fiscal integrity, for example, means using FY85 dollars for the approved FY85 program, FY86 dollars for the FY86 program and so on. Appropriation

integrity means, for example, that 3010 money will be used to procure aircraft or that 3020 money will be used to procure missiles.

Financial Management end products include the POM and BES, fund status, funding documents, and the program baseline. The POM identifies total program requirements in ranked format for the next five years, and includes rationale in support of the planned changes from the approved Five Year Defense Program (*FYDP*) Baseline. The POM is based on strategic concepts and guidance stated in the Defense Guidance and includes an assessment of the risk associated with current and proposed forces. The BES is a recosting of the POM as modified by the Program Decision Memorandum (*PDM*). It should be noted that new requirements cannot be introduced in the BES, only in the POM. Another end product of financial management is the status of funds. Weighing the contractors EAC to the SPO's budget is a daily activity. At any time, a financial analyst should be able to provide the status of 3600, 3080, 3010, or 3020 funds with regard to expenditures and obligations. The following definitions describe common financial terms and concepts:

Obligation -- Legally binding contract between government and contractor.

Commitment -- SPO or Comptroller administrative reservation of funds for future use.

Expenditure -- Actual payment of money to contractor.

Plans and integration functions include scheduling, documentation review, program analysis, computer support, and reports control. A key element in scheduling is the Integrated Master Schedule. An integrated master schedule is a detailed program schedule that portrays all of the major elements of a program and all related development efforts so that the interrelationships are easily seen. Since it is the integrated schedule, it is updated regularly and is recognized as the only authorized source for publication of schedule information outside the program office. The other functions of plans and integration deal with supporting the program manager in non-financial aspects. For instance, documentation reviews are held to analyze all descriptive information concerning activities between federal agencies and/or the contractor. These documents usually delineate policy or elevate issues so that options can be addressed. In a system of plans, the program manager's (and the team's) strategy to achieve the objective is integrated in the Program Management Plan and detailed in plans such as the Acquisition Plan, Test and Evaluation Master Plan, Integrated Logistics Support Plan, and lower-level functional plans.

End products associated with plans and integration include the master integrated schedule, internal reports, and ensuring that the Program Management Directive and AFSC Form 56 are valid and current.

In discussing how program control supports the program manager, one needs to realize that there is a close relationship between plans, schedules, cost estimates, and budgets and how they all form the program baseline. The baseline is the standard or yardstick through which program status is determined and potential problems are identified. To perform these functions then, some program infrastructure is required. Some method for relating the parts to the whole and aggregating information at an appropriate level of detail is essential. The Work Breakdown Structure (*WBS*) is the infrastructure or vehicle doing this. A WBS is a product-oriented family tree composed

of hardware, services, and data which results from project engineering efforts during development and production of a defense system or equipment item, and which completely defines the project/program. A WBS displays and defines the product(s) to be developed or produced and relates the elements of work to be accomplished to each other and to the end product. Each WBS is constructed in levels. Level one is the entire system or item: for example, the E-3A Sentry AWACS system. Level two consists of the major elements of the system: for example, an air vehicle, data, or aggregations of services such as system/project management and system test and evaluation. Level three is the next level of decomposition of the entire system into its components. Level three elements would include the attitude control subsystem, or a specific type of service or data such as development test and evaluation or engineering data. Lower levels are identified as necessary to completely define the elements of the program. MIL-STD-881-A and AFR 800-17 provide policy and guidance on the WBS.

The WBS supports the program control and cost estimating function by being the foundation for all SPO discussion on costs, plans, and schedules both within the government and between the government and the contractor. The WBS provides a way for people of various backgrounds and perspectives to talk intelligently about issues important to everyone in the SPO. The work breakdown structure permeates the program in all management areas: planning, organizing, directing, and controlling.

Let's address the four areas of the budgetary process. The first is budget formulation. Program Control's involvement is most extensive in this phase since this is where the SPO budget is formulated. This budget is based on the required costs necessary to satisfy program requirements. Cost estimating is the important activity here in the budgetary process because this is where costs are developed and identified. Usually, SPO budgets are based on validated cost estimates or cost estimates that have been reviewed and approved based on consistency, completeness, reasonableness, and documentation. Once the budget is formulated, the program manager agrees to delivering a weapon system for a certain cost and this is documented in the program baseline.

The second phase, enactment, is getting authorization and hence, appropriated funds designated for your program. The best way to *win* your case for appropriated funds is through good documentation. Good documentation can highlight the importance of your program especially when congressional interest is high. It is this type of justification that leads to an approved program.

The execution phase involves putting approved funds to work and the fourth budgetary area is analysis and reporting. The analysis and reporting phase involves all activities in support of the Air Force briefing process. The main concept behind the briefing process is to resolve issues before they become critical by presenting cost and schedule information to those in higher decision positions.

We have been addressing the unique and interrelated functions in acquisition management throughout this course. One function of acquisition management that gets a lot of public attention is military acquisition costs. One cannot escape the attention given to military costs in most trade journals, major newspapers, and other forms of media. Suffice it to say that military performance is tied directly to cost effectiveness. The peacetime measurement of *how are we doing* has been attached to costs, or more exactly, cost estimates. Cost estimating is the basis upon which budgets are formulated and revised. A program's cost estimate, therefore, is that baseline or *anchor* that keeps

the program's costs tied to a number representing the program's key elements with corresponding dollar values. When all these dollars are summed into the Department of Defense's (*DOD*) budget, or Total Obligation Authority, it takes up a sizable portion of our nation's tax dollars. Therefore, it is no wonder that so much attention is given to the DOD budget and to our cost estimating process.

The acquisition process requires and focuses on the cost estimate of a system and the availability of adequate funding levels at the proper time. It is mandatory that cost estimates accurately reflect program financial requirements. A program's viability can be seriously impacted if measured against a less than competent estimate. Any discussion of cost estimating usually begins with a definition. Cost estimating is defined in AFSCM 173-1, *Cost Analysis Procedures*, as . . . *the process of projecting financial requirements to accomplish a specified objective. It includes selecting estimating structures; collecting, evaluating, and applying data; choosing and applying estimating methods; and providing full documentation.* Additionally, it should be emphasized that the cost estimating process occurs at a specific point in time and, therefore, is as accurate as the information used in its formation.

Key to understanding the cost estimating process is an appreciation of its iterative and dynamic nature. One program may go through multiple cost estimating projects dependent on the acquisition or budget cycle. Cost estimates, therefore, serve several functions. One is to provide key information early in a program's life in the establishment of a program baseline. At this point in a program's life cycle, it is crucial to develop as accurate a cost estimate as possible because many complex and important decisions are made, based on this estimate, that affect the program throughout the program's life until disposal. Remember the discussion on Integrated Logistics Support which identified that seventy percent of the life cycle costs of a system are committed by Milestone One, by Milestone Two, eighty-five percent and by Milestone Three, about ninety-five percent. Intuitively, early program cost estimates are crucial to a program's success.

On the Product Division staff, the Comptroller serves as an independent check of the SPO cost estimate. Generally, there are also four categories of cost analysis that the Comptroller may perform using Program Control representatives. These include the Independent Cost Analysis (*ICA*) required on all major programs, the Independent Cost Study (*ICS*), the Independent Sufficiency Review (*ISR*), and the Independent Schedule Assessment (*ISA*).

HQ USAF/ACC manages the ICA program based on AFR 173-1. An ICA is a complex effort requiring a life cycle cost estimate for the Defense Acquisition Board (*DAB*) and/or the Air Force Systems Acquisition Review Council (*AFSARC*). ICAs also include a detailed risk assessment and sensitivity analysis.

The ICS is unique in that it can be generated in the program office or by the comptroller depending on who tasked the requirement for the cost estimate. The ICS has less scope than an ICA since there is no life cycle cost estimate requirement.

The ISA features an analysis of the program schedule and milestones for reasonableness and consistency with current direction.

The ISR is used to analyze the SPO cost estimate for completeness, reasonableness, consistency, and documentation. The key is the independent nature of the ISR as a

check on the accuracy of the SPO estimate.

These cost estimates, subsequently, are required for development and representation of program costs in the budgetary and acquisition cycles. Cost estimates are commonly required for each Milestone decision, for impact studies when the program's technical content changes, if previous cost estimates are obsolete, and upon direction or tasking to do so. Cost estimates are also used in source selections to provide support information for comparison with contractor proposals. The type of cost estimate greatly depends on the requirement, program information available, and time allowed for estimate development.

Understanding the characteristics of an acceptable cost estimate will also be of assistance in presenting program information efficiently and effectively. The first characteristic is completeness. A cost estimate should include everything that the SPO has been tasked to do and deliver. Specifically, all costs must be inflated correctly and included in the estimate. These costs must conform to the WBS format and be based on actual, current information. Efforts must be made to ensure costs included in the estimate are pertinent to the program.

The second characteristic is reasonableness. The cost estimate methodology and logic should agree with current policies and should be appropriate for the program being estimated. Any data bases used as references in the cost estimate should be valid and applicable. The assumptions, learning curve, and other factors used in the estimate should be reasonable and applicable.

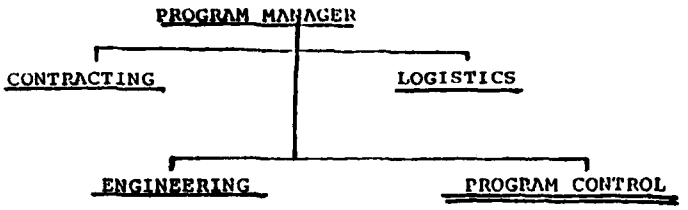
The third characteristic of a good cost estimate is consistency. Any inconsistencies between the cost estimate and acquisition strategy are analyzed. The SPO's acquisition strategy or plan should subsequently be consistent with the latest program direction and schedule. All ground rules and assumptions made in the cost estimate should be consistent with current direction. Any differences between the cost estimate and previous estimates are addressed and analyzed.

Finally, the last characteristic of a good estimate is quality documentation. Documentation must be clear, concise, and explicit in supporting statements made in the cost estimate. Documentation must be presented and organized in accordance with AFR 173-1.

Documentation should clearly explain how the estimate was developed, what methods were used in each WBS area, what models were used to generate costs and the projected accuracy of the model's estimated costs pertaining to your program, the team members involved who developed the cost estimate, and the logic behind the estimate's creation and organization. Documentation is the key to separating a good estimate from a bad one for the single reason that the estimate can be reviewed, updated, or analyzed by others separate from the program or comptroller. Because of the iterative nature of the acquisition process, one program can easily go through multiple cost estimates in its life time. A common thread needs to flow from one cost estimate to the next, if possible. Documentation facilitates this flow, especially when the original cost estimator on that program probably will not be the same estimator on that program ten or even five years down the road. Documentation is a valuable resource in cost estimating because it provides a means of transferring logic and thought across time, as a program is being developed, for showing the logic behind important decisions or reasons for historical cost

growth.

Since the public is so interested in the cost growth of military systems, one needs to have an appreciation for the basic reasons that drive this cost growth. One historical factor that has led to weapon system cost growth is the loss of estimating expertise continuity. Failure to analyze program costs the same way or with the same objectives or background leads to inconsistencies. Documentation can help alleviate this problem. A second potential factor is the use of historical costs for gauging future program costs. Is it correct to assume that current programs under development now will follow cost patterns of historical weapon systems? Most in the cost field agree historical costs are usable but with certain constraints. Usually programs use adjustment factors to tailor their program costs by comparing their system and their estimated costs with the costs of historical programs. These comparisons are useful and necessary in providing the basis on which to estimate and present costs. Subsequently, new cost estimating methods are constantly being developed in order to refine and improve the use of historical costs. Other cost growth factors include limited program definition, difficulty quantifying program risk, limited funding, questionable material availability, and the overall failure to include all costs. Trying to account for these factors when developing a program's estimated cost is best left up to people with the corporate knowledge and expertise in doing cost estimates, usually Program Control and Comptroller personnel.



AIR FORCE INSTITUTE OF TECHNOLOGY

PROGRAM CONTROL
THREE DIVISIONS

PROGRAM EVALUATION

FINANCIAL MANAGEMENT

PLANS AND INTEGRATION

WORK BREAKDOWN STRUCTURE
THE COMMON THREAD

WORK BREAKDOWN STRUCTURE (WBS)
DEFINES TOTAL PROGRAM

RELATES PARTS TO WHOLE

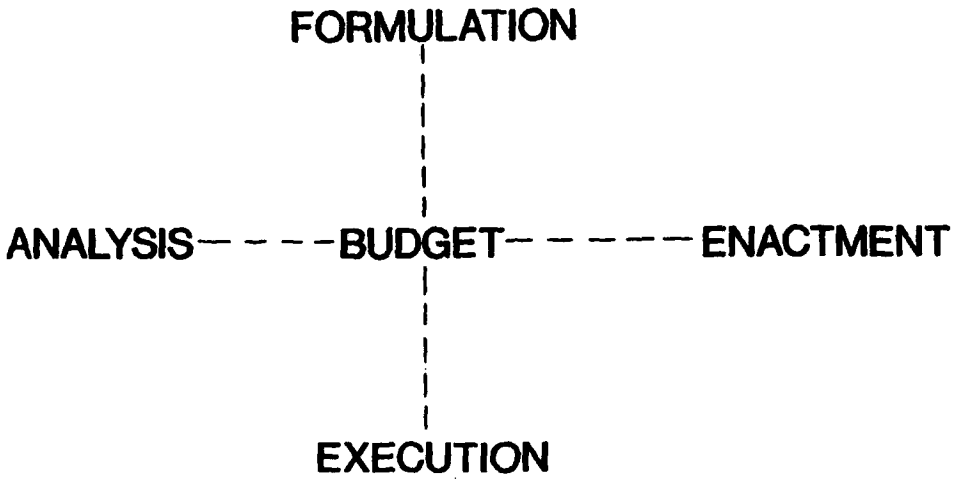
FOUNDATION FOR:
- PLANS
- SCHEDULES
- STATEMENT OF WORK
- CONTRACT LINE ITEMS
- PROGRESS/PROBLEM DETERMINATION

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WBS COST ELEMENTS

HARDWARE
SOFTWARE
AUTOMATIC TEST EQUIPMENT (ATE)
TOOLING
PECULIAR SUPPORT EQUIPMENT (PSE)
DATA
TRAINING
MISSION SUPPORT
MANAGEMENT RESERVE/ENGINEERING
CHANGE ORDERS (ECO)

BUDGET IS EVERYTHING



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FORMULATION

THE BASELINED PROGRAM (FISCAL CONSTRAINTS)

COST ESTIMATES
- PROGRAM OFFICE
- INDEPENDENT

BUDGET DEVELOPMENT

ENACTMENT

DOCUMENTATION

JUSTIFICATION

TESTIMONY

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EXECUTION

REDIRECTED PROGRAM - ENACTED

FINANCIAL TRANSACTIONS

COMMITMENTS

OBLIGATIONS

EXPENDITURES

FINANCIAL TRANSACTIONS
DEFINITIONS

COMMITMENT
- RESERVATION OF FUNDS FOR FUTURE OBLIGATIONS

OBLIGATION
- LEGAL RESERVATION OF FUNDS (e.g. A CONTRACT)

EXPENDITURE
- PAYMENT MADE AGAINST AN OBLIGATION

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EXECUTION (CON'T)

FORECASTING
- COMMITMENTS AND OBLIGATIONS (COMPARED TO APPROPRIATION ACT)
- EXPENDITURES (ESSENTIAL TO TREASUREY DEPT)

FUNDS STATUS REPORTING
- MONTHLY FUNDS UTILIZATION
- FUNDS FORECAST/STATUS SUMMARY

ANALYSIS AND REPORTING

INTERNAL MANAGEMENT (PROGRAM OFFICE)
- INTERNAL FINANCIAL REVIEWS
- CONTRACTOR COST AND SCHEDULE PERFORMANCE
- STATUS OF FUNDS
- TRACKING OBLIGATIONS AND EXPENDITURES
- UNFUNDED REQUIREMENTS
- IMPACT STATEMENTS

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ANALYSIS AND REPORTING
(CON'T)

EXTERNAL MANAGEMENT
- DIVISION
  - SUFFICIENCY REVIEWS
  - FUNCTIONAL MANAGEMENT REVIEWS

HQ AFSC
- PROGRAM FINANCIAL REVIEW (PFR)
- PROGRAM/COMMAND ASSESSMENT REVIEW (PAR/CAR)
- PROGRAM BASELINE

CONGRESSIONAL
- SELECTED ACQUISITION REPORT (SAR)
- UNIT COST REPORTS

REGULATORY GUIDE

AFR 173-1

THE AIR FORCE COST ANALYSIS PROGRAM

GENERAL POLICY

OUTLINES RESPONSIBILITIES

DOCUMENTATION GUIDANCE AND CRITERIA

AIR FORCE INSTITUTE OF TECHNOLOGY

HQ DIRECTED ANALYSES

CHARACTERISTICS

AFR 173-1 AND AFR 173-11
INITIATED VIA TASKING MESSAGE
SUPPORTS DAB/AFSARC PROCESS OR
AS DIRECTED
CATEGORIES OF EFFORT:
ICA - INDEPENDENT COST ANALYSIS
ICS - INDEPENDENT COST STUDY
ISA - INDEPENDENT SCHEDULE ASSMT
ISR - INDEPENDENT SUFFICIENCY RVW
TEAM ORGNLLY SEPARATE
PRESENTED TO OSD CAIG/AF CAIG

COST ESTIMATING
FUNCTIONS

DIRECTORATE STAFF
- ICA
- ISR
- ICS
- ISA

PROGRAM CONTROL (SPO)
- ANNUAL ESTIMATES
- POM
- BES
- PFR/PAR/CAR/SAR
- BASELINE ESTIMATES

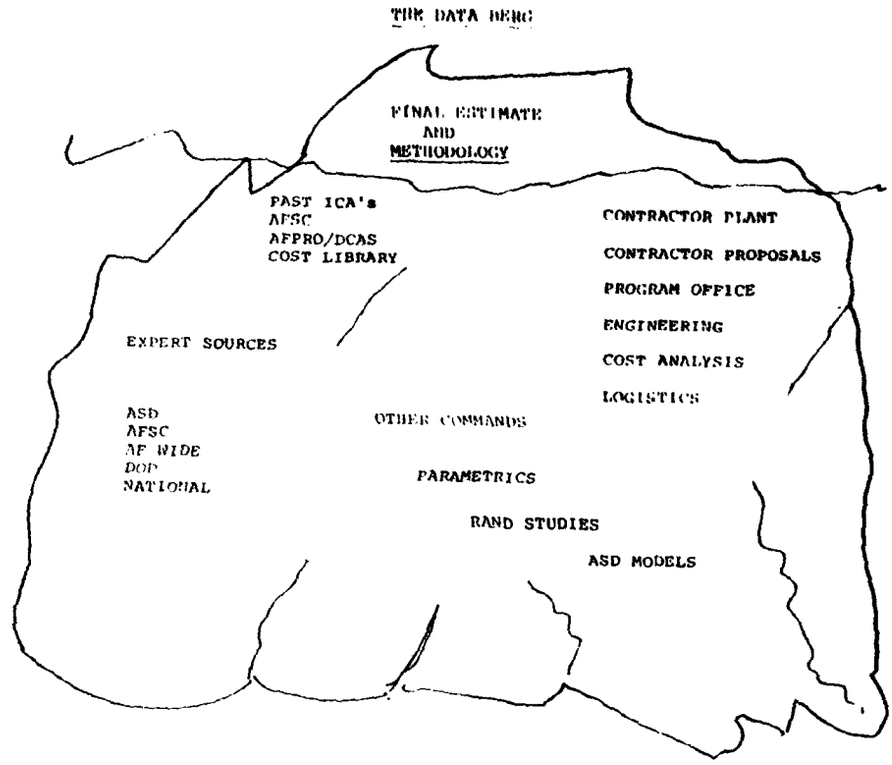
SUFFICIENCY REVIEWS
CRITERIA

COMPLETENESS

REASONABLENESS

CONSISTENCY

DOCUMENTATION



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COST GROWTH

SYSTEMATIC COST GROWTH
- LOSS OF EXPERTISE
- HISTORICAL COST MODELS

UNSYSTEMATIC COST GROWTH
- LIMITED TECHNICAL DEFINITION
- DIFFICULTY QUANTIFYING PROGRAM RISK
- LIMITED FUNDING
- MATERIAL AVAILABILITY
- FAILURE TO INCLUDE ALL COSTS

ACRONYMS

ACO	Administrative Contracting Officer
ACSN	Advanced Change/Study Notices
ADM	Acquisition Decision Memorandum
ADTC	Armament Development Test Center
AEDC	Arnold Engineering & Development Center
AFDAP	Air Force Designated Acquisition Program(s)
AFFTC	Air Force Flight Test Center
AFOTEC	Air Force Operational Test and Evaluation Center
AFPRO	Air Force Plant Representative
AFSARC	Air Force System Acquisition Review Council
AMSDL	Acquisition Management Systems & Data Requirements Control List
ATE	Automatic Test Equipment
BES	Budget Estimate Submission
C/SCSC	Cost/Schedule Control Systems Criteria
C/SSR	Cost/Schedule Status Reviews
CAOs	Contract Administration Organization(s)
CAR	Command Assessment Reviews
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CFSR	Contract Funds Status Reports
CI	Configuration Item(s)
CINCs	Commanders-in-Chief of the Unified and Specified Commands
CM	Configuration Management
CO	Contracting Officer
CPFF	Cost-Plus-Fixed-Fee
CPIF	Cost-Plus-Incentive-Fee
CPR	Cost Performance Reports
CRS	Computer Resources Support
C^3	Command, Control and Communication
DAB	Defense Acquisition Board
DAE	Defense Acquisition Executive
DAL	Data Accession List
DAPCA	Development and Production Cost of Aircraft
DBDD	Data Base Design Documents
DCAS	Defense Contract Administrative Services
DCASMAs	Defense Contract Administrative Services Management Areas
DCASPROs	Defense Contract Administrative Services Plant Representative Office
DCASRs	Defense Contract Administrative Services Regions
DCP	Decision Coordinating Paper

DDMO	Defense Data Management Office
DG	Defense Guidance
DIDs	Data Item Description(s)
DMO	Data Management Officer
DNFYP	Department of the Navy Five Year Program
DOD	Department of Defense
DODD	Department of Defense Directive
DPML	Deputy Program Manager for Logistics
DRB	Defense Resources Board
DRRB	Data Requirements Review Board
DSRD	Depot Support Requirements Document
DSSP	Defense Standardization & Specification Program
DT&E	Development Test and Evaluation
EAC	Estimate at Completion
ECPs	Engineering Change Proposals
EDMO	Engineering Data Management Officer
FAR	Federal Acquisition Regulation
FCA	Functional Configuration Audit
FFP	Firm Fixed-Price
FMC	Fully Mission Capable
FOT&E	Follow-On Operational Test and Evaluation
FPI	Fixed-Price Incentive
FQR	Formal Qualification Review
FSD	Full Scale Development
FYDP	Five Year Defense Program
GAO	General Accounting Office
GBL	Government Bill of Lading
GFP	Government Furnished Property
ICA	Independent Cost Analysis
ICBM	Intercontinental Ballistic Missile
ICS	Independent Cost Study
IDD	Interface Design Documents
IFB	Invitations for Bids
ILS	Integrated Logistics Support
ILSM	Integrated Logistics Support Manager
ILSP	Integrated Logistics Support Plan
IMIP	Industrial Modernization Incentive Program
IOC	Initial Operational Capability
IOT&E	Initial Operational Test and Evaluation
IP	Issue Paper
IPS	Integrated Program Summary
ISA	Independent Schedule Assessment
ISR	Independent Sufficiency Review

CS	Joint Chiefs of Staff
JPAM	Joint Program Assessment Memorandum
JSOR	Joint Systems Operational Requirement
JSPD	Joint Strategic Planning Document
JT&E	Joint Test and Evaluation
JTD	Joint Test Director
JTF	Joint Task Force
LCC	Life Cycle Cost
LRIP	Low Rate Initial Production
LSA	Logistics Support Analysis
MAR	Management Assessment Reviews
MNS	Mission Need Statement
MST&E	Multi-Service Test and Evaluation
O&M	Operation and Maintenance
OMB	Office of Management and Budget
OPR	Office of Primary Responsibility
OT&E	Operational Test and Evaluation
PAD	Program Action Directive
PCA	Physical Configuration Audit
PCO	Procuring Contracting Officer
PDM	Program Decision Memorandum
PDP	Program Decision Package
PDR	Preliminary Design Review
P^3I	PrePlanned Product Improvement
PEM	Program Element Monitor
PEO	Program Executive Officer
PFRs	Program Financial Reviews
PHS&T	Packaging, Handling, Storage & Transportation
PM	Program Manager
PMD	Program Management Directive
PMP	Program Management Plan
PMRT	Program Management Responsibility Transfer
PO	Program Office
POM	Program Objective Memorandum
PPBS	Planning, Programming and Budgeting System
PR	Purchase Request
PRO	Plant Representative Office
PRR	Production Readiness Review(s)
PTO	Participating Test Organization
QOT&E	Qualifying Operational Test & Evaluation
QT&E	Qualification Test and Evaluation
R&M	Reliability and Maintainability
RCM	Requirements Correlation Matrix

RDT&E	Research, Development, Test and Evaluation
RFP	Request(s) for Proposal
RFQ's	Requests for Quotations
RTO	Responsible Test Organization
SAF	Secretary of the Air Force
SAFPAR	Secretary of the Air Force Program Assessment Review
SAR	Selected Acquisition Reports
SCP	System Concept Paper
SDDD	Software Detail Design Documents
SDR	System Design Review
SE	Support Equipment
SECDEF	Secretary of Defense
SOA	Separate Operating Agencies
SOC	System Operational Concept
SON	Statement of Operational Need
SORD	System Operational Requirements Document
SOW	Statement of Work
SPO	System Program Office
SRR	System Requirements Review
SSA	Source Selection Authority
SSAC	Source Selection Advisory Council
SSEB	Source Selection Evaluation Board
SSP	Source Selection Plan
SSR	Software Specification Review
SYSTO	Systems Officer
T&E	Test and Evaluation
TBD	To Be Determined
TCO	Termination Contracting Officer
TEMP	Test and Evaluation Master Plan
TOs	Technical Order(s)
TPWG	Test Plan Working Group
TRR	Test Readiness Review
WBS	Work Breakdown Structure

INDEX

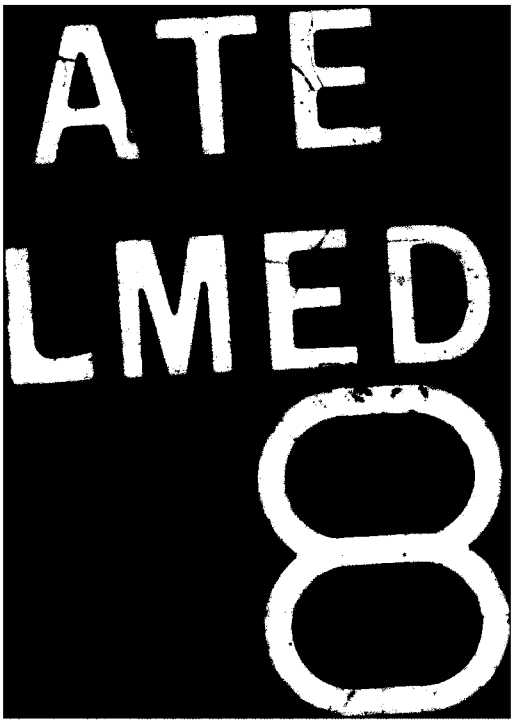
ARTICLE	PAGE #
The Acquisition of Major Systems, Mr Dyke McCarty, AFIT/LSY	1-4
Operational Requirements Process, Captain Richard A. Andrews, AFIT/LSY	1-22
Matrix Management: Is It Right For Weapons Acquisition, Program Managers Newsletter (Sept-Oct 1978) Dr. Michael B. Patterson (Babson College)	2-3
Program Management Program Manager Responsibility, Capt Terry R. Adler, AFIT/LSY	3-4
Air Force Reliability and Maintainability Program, United States Air Force "FACT SHEET" 85-27 December 1985	4-4
Planning, Programming and Budgeting System, Mr. Dyke McCarty, AFIT/LSY	5-4
The Solicitation Process, Capt Terry R. Adler, AFIT/LSY	6-4
AFSC Regulation 550-23, 28 Jul 87, *Streamlined Source Selection*	6-14
Contracting Authority, Major Richard H. Sand, AFIT/LSP; Edited by Capt Terry Adler	7-5
Communication Exercise	8-1
The Systems Engineering Process, Professor William A. Dean, AFIT/LSY	9-4
Introduction to ILS, Capt Richard A. Andrews, AFIT/LSY	10-3
We Still Worry About Configuration Management, Professor William A. Dean, AFIT/LSY	11-4
An Overview of Data Management, Mr. Samuel J. Epstein, AFIT/LSY	12-4
Reducing the Cost of Data Acquisition (Buying Data), "Program Manager", Jan-Feb 1985, Mr. Alan W. Beck	12-11
Manufacturing Management in the Weapon System Acquisition Process, Major Charles M. Farr, AFIT/LSY	13-4
Test and Evaluation, Majors Huffman, Lozito & Snyder May 1981, ACSC, Air University, Maxwell AFB, AL	14-4

RTO/PTO Organizations, Capt Terry Adler, AFIT/LSY 14-10

Program Control and Cost Estimating, Capt Terry Adler, AFIT/LSY 15-4

APPENDIX A ACRONYMS A-1

INDEX I-1


ATE
LMED
8